A.O.SMITH

COPPER BOILERS FOR HYDRONIC HEATING AND HOT WATER SUPPLY

- **Installation**
- **Operation**
- **Maintenance**
- **Limited Warranty**

Instruction Manual
GB/GW MODELS:
1000, 1300, 1500, 1850, 2100, 2500
SERIES: 300, 301, 302, 303, 304, 305

FM APPROVED

WARNING: If the information in this manual is not followed exactly, a fire or explosion may result causing property damage, personal injury or loss of life.

- **Do not store or use gasoline or other flammable vapors and liquids in the vicinity of this or any other appliance.**

WHAT TO DO IF YOU SMELL GAS:

- **Extinguish any open flame.**
- **Do not try to light any appliance.**
- **Do not touch any electrical switch; do not use any phone in your building.**
- **Immediately call your gas supplier from a neighbor's phone. Follow the gas supplier's instructions.**
- **If you cannot reach your gas supplier, call the fire department.**

- **Installation and service must be performed by a qualified installer, service agency or the gas supplier.**

PLACE THESE INSTRUCTIONS ADJACENT TO BOILER AND NOTIFY OWNER TO KEEP FOR FUTURE REFERENCE.

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CAUTION

TEXT PRINTED OR OUTLINED IN RED CONTAINS INFORMATION RELATIVE TO YOUR SAFETY. PLEASE READ THOROUGHLY BEFORE INSTALLING AND USING THIS APPLIANCE.

Thank You

for buying this cost efficient, high recovery unit from A. O. Smith Water Products Co.

You should thoroughly read and understand this manual before installation and/or operation of this boiler. Please pay particular attention to the important safety and operating instructions as well as the WARNINGS and CAUTIONS.

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A.O.SMITH
WATER PRODUCTS COMPANY
A DIVISION OF A. O. SMITH CORPORATION
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STRATFORD-ONTARIO, VELDHOVEN-THE NETHERLANDS
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PART NO. 211816-000

ROUGH-IN DIMENSIONS

IMPORTANT!
Refer to "Installation Clearances" section of manual (page 7) for recommended service clearances prior to boiler placement.

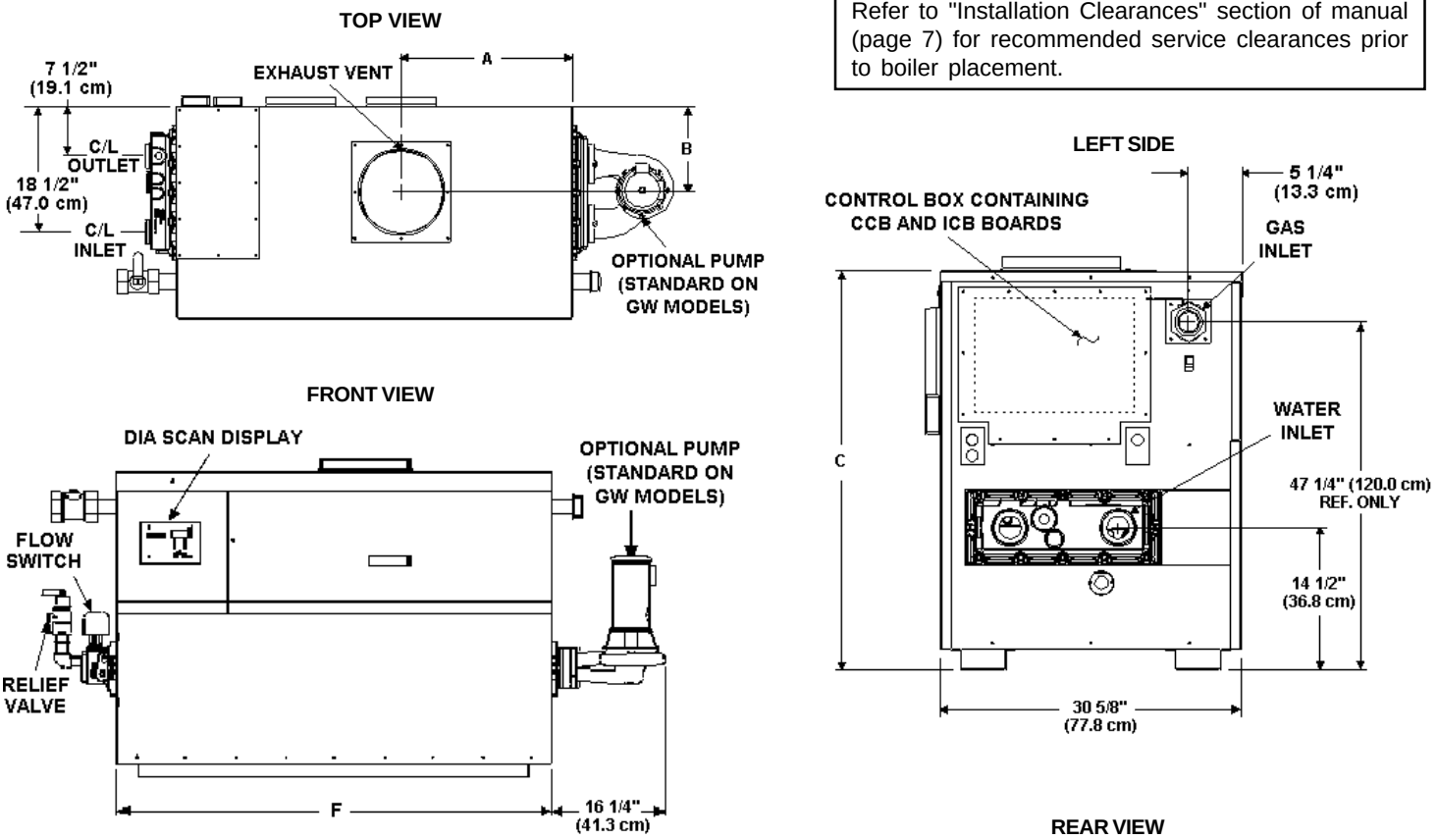


Figure 1.

TABLE 1: GAS AND ELECTRICAL CHARACTERISTICS

MODEL	Manifold Pressure		Electrical Characteristics		
	Type of Gas	Inches W.C.	kPa	Volts/Hz	Amperes
GW/GB-1000 thru 2500	NATURAL	3.5	0.87	120/60	30
GW/GB-1000 thru 2500	PROPANE	10	2.49	120/60	30

All Models - Maximum Supply Pressure: 14.0 In. W.C. (3.49 kPa)
Minimum Supply Pressure Natural Gas: 6.0 In. W.C. (1.22 kPa)
Minimum Supply Pressure Propane Gas: 11.0 In. W.C. (2.74 kPa)
Minimum Pressures must be maintained under both load and no load (static and dynamic) conditions.

TABLE 2. ROUGH - IN DIMENSIONS

Model	A		B		C		D		E		F	
	Inches	cm	Inches	cm	Inches	cm	Inches	cm	Inches	cm	Inches	cm
GW/GB-1000	14.1	35.8	12.2	31.0	40.3	102.4	31.6	80.3	26.0	66.0	46.8	118.9
GW/GB-1300	24.8	63.0	12.2	31.0	40.3	102.4	31.6	80.3	39.3	99.8	57.3	145.5
GW/GB-1500	30.2	76.7	12.2	31.0	40.3	102.4	31.6	80.3	44.6	113.3	64.3	163.3
GW/GB-1850	27.7	70.4	11.2	28.4	43.0	109.2	32.3	82.0	44.0	111.8	78.3	198.9
GW/GB-2100	31.0	78.7	11.2	28.4	43.0	109.2	32.3	82.0	49.5	125.7	85.3	216.7
GW/GB-2500	38.1	96.8	10.5	26.7	43.0	109.2	32.3	82.0	56.5	143.5	99.3	252.2

Model	Input				Exhaust Vent Diameter		Air Intake Vent Diameter		Water Conn. Size	Gas Inlet
	BTU/Hr. Natural Gas	KW Natural Gas	BTU/Hr. Propane Gas	KW Propane Gas	Inches	cm	Inches	cm		
GW/GB-1000	990,000	289.95	990,000	289.95	10	25.4	8	20.3	2 1/2 NPT	2 NPT
GW/GB-1300	1,300,000	380.74	1,300,000	380.74	12	30.5	10	25.4	2 1/2 NPT	2 NPT
GW/GB-1500	1,500,000	439.31	1,500,000	439.31	12	30.5	10	25.4	2 1/2 NPT	2 NPT
GW/GB-1850	1,850,000	541.82	1,850,000	541.82	14	35.6	10	25.4	2 1/2 NPT	2 1/2 NPT
GW/GB-2100	2,100,000	615.04	2,100,000	615.04	14	35.6	12	30.5	2 1/2 NPT	2 1/2 NPT
GW/GB-2500	2,490,000	729.26	2,490,000	729.26	16	40.7	12	30.5	2 1/2 NPT	2 1/2 NPT

TABLE 3: RECOVERY CAPACITIES

MODEL	Input Rating BTU/Hr. (kW)	Gal/Liter per Hr.	TEMPERATURE RISE - DEGREES °F (°C)									
			40°F (22.2°)	50°F (27.7°)	60°F (33.3°)	70°F (38.8°)	80°F (44.4°)	90°F (50°)	100°F (55.5°)	110°F (61.1°)	120°F (66.7°)	130°F (72.2°)
GW - 1000	990,000 (290.1)	LPH	9526	7620	6350	5443	4763	4234	3810	3462	3175	2930
		GPH	2520	2016	1680	1440	1260	1120	1008	916	840	775
GW - 1300	1,300,000 (380.9)	LPH	12508	10006	8339	7148	6256	5560	5005	4547	4169	3848
		GPH	3309	2647	2206	1891	1655	1471	1324	1203	1103	1018
GW - 1500	1,500,000 (439.5)	LPH	14432	11548	9620	8248	7216	6415	5772	5247	4812	4442
		GPH	3818	3055	2545	2182	1909	1697	1527	1388	1273	1175
GW - 1850	1,850,000 (542.0)	LPH	17800	14239	11865	10172	8902	7912	7122	6471	5935	5477
		GPH	4709	3767	3139	2691	2355	2093	1884	1712	1570	1449
GW - 2100	2,100,000 (615.3)	LPH	20204	16163	13472	11548	10104	8981	8082	7348	6736	6218
		GPH	5345	4276	3564	3055	2673	2376	2138	1944	1782	1645
GW - 2500	2,490,000 (729.6)	LPH	23958	19168	15971	13691	11979	10648	9582	8713	7987	7371
		GPH	6338	5071	4225	3622	3169	2817	2535	2305	2113	1950

TABLE 4: HEAT EXCHANGER PRESSURE DROP

MODEL	GB MODELS-FLOW, HEAD LOSS AND TEMPERATURE RISE											
	20 Deg. F Rise		30 Deg. F Rise		40 Deg. F Rise		Maximum Flow Rate			Minimum Flow Rate		
	GPM	PD-FT Head	GPM	PD-FT Head	GPM	PD-FT Head	GPM	PD-FT Head	Deg. F Rise	GPM	PD-FT Head	Deg. F Rise
GB - 1000	83.16	5.1	55.4	2.7	41.6	1.5	154	12.2	11	42	1.5	40
GB - 1300	109.2	7.2	72.8	4.2	54.6	3.2	154	14.5	14	55	3.2	40
GB - 1500	126	10.1	84	6.3	63	4.3	154	16.3	17	64	4.3	40
GB - 1850	154	18.5	103.6	10.1	77.7	6.4	154	18.5	20	78	6.4	40
GB - 2100	n/a	n/a	117.6	14.5	88.2	8.3	154	21.3	23	89	8.3	40
GB - 2500	n/a	n/a	139.4	18.5	104.6	11.6	154	23.2	28	105	11.6	40

Note: GW models (GB optional) are equipped with pumps capable of handling 50 equivalent feet (15.2 m) of normal pipe fittings.

FOREWORD

These designs comply with the latest edition of the American National Standards for Gas-Fired, Low-Pressure Steam and Hot Water Boilers, ANSI Z21.13-2000 and CSA 4.9-2000 latest edition, as a low pressure boiler.

Detailed installation diagrams are found in this manual. These diagrams will serve to provide the installer a reference for the materials and methods of piping necessary. It is essential that all water, gas piping and wiring be installed as shown on the diagrams. You should thoroughly read and understand this manual before installation and/or operation of this boiler.

The factory warranty will be void if the boiler(s) have been improperly installed or operated.

In addition to these instructions, the boiler(s) shall be installed in accordance with those installation regulations in force in the local area where the installation is to be made. These shall be carefully followed in all cases. Authorities having jurisdiction should be consulted before installations are made.

In the absence of local codes, the installation must comply with the latest editions.

In the United States:
The National Fuel Gas Code, ANSI Z223.1/NFPA 54
and the National Electric Code, NFPA 70.

In Canada:
The installation Code CAN/CSA B149.1 and .2 (latest edition)
and the Canadian Electric Code, CSA C22.2.

These codes are available from CSA International, located at: 8501 East Pleasant Valley Road, Cleveland, OH 44131, USA, or 5060 Spectrum Way, Suite 100, Mississauga, Ontario L4W 5N6 in Canada.

GROUNDING INSTRUCTIONS

This boiler must be grounded in accordance with the National Electrical Code and/or local codes. The boiler is polarity sensitive, correct wiring is imperative for proper operation.

This boiler must be connected to a grounded metal, permanent wiring system, or an equipment grounding conductor must be run with the circuit conductors and connected to the equipment grounding terminal or lead on the boiler.

WARNING

YOUR BOILER IS NOT DESIGNED TO OPERATE WITH A BOILER INLET WATER TEMPERATURE OF LESS THAN 120°F (49°C). COLDER INLET WATER TEMPERATURE WILL RESULT IN SIGNIFICANT CONDENSATION DEVELOPING ON THE HEAT EXCHANGER. THIS SITUATION CAN CAUSE A CORROSIVE ENVIRONMENT FOR THE HEAT EXCHANGER, BURNERS AND VENTING RESULTING IN PREMATURE DAMAGE, WHICH COULD RESULT IN SERIOUS PERSONAL INJURY OR DEATH.

FOR SYSTEMS THAT USE LARGE VOLUMES OF COLD WATER OR SYSTEMS UTILIZING HEAVY WATER DRAWS, CONDENSATION CAN BE PREVENTED BY USING A BYPASS LOOP.

CORRECT GAS

Make sure the gas on which the boiler will operate is the same as that specified on the boiler rating plate. Do not install the boiler if equipped for a different type of gas, consult your gas supplier.

PRECAUTIONS

IF THE UNIT IS EXPOSED TO THE FOLLOWING, DO NOT OPERATE UNTIL ALL CORRECTIVE STEPS HAVE BEEN MADE BY A QUALIFIED SERVICEMAN:

1. EXPOSURE TO FIRE.
2. IF DAMAGED.
3. FIRING WITHOUT WATER.
4. SOOTING.

IF THE BOILER HAS BEEN EXPOSED TO FLOODING, IT MUST BE REPLACED.

LIQUID PETROLEUM MODELS

Boilers for propane or liquefied petroleum gas (LPG) are different from natural gas models. A natural gas boiler will not function safely on LP gas and no attempt should be made to convert a boiler from natural gas to LP gas.

LP gas must be used with great caution. It is highly explosive and heavier than air. It collects first in the low areas making its odor difficult to detect at nose level. If LP gas is present or even suspected, do not attempt to find the cause yourself. Leave the building, leaving doors open to ventilate, then call your gas supplier or service agent. Keep area clear until a service call has been made.

At times you may not be able to smell an LP gas leak. One cause is odor fade, which is a loss of the chemical odorant that gives LP gas its distinctive smell. Another cause can be your physical condition, such as having a cold or diminishing sense of smell with age. For these reasons, the use of a propane gas detector is recommended.

IF YOU EXPERIENCE AN OUT OF GAS SITUATION, DO NOT TRY TO RELIGHT APPLIANCES YOURSELF. Call your local service agent. Only trained LP professionals should conduct the required safety checks in accordance with industry standards.

HIGH ALTITUDE INSTALLATION

WARNING

INSTALLATIONS ABOVE 4,500 FEET REQUIRE REPLACEMENT OF THE BURNER ORIFICES IN ACCORDANCE WITH THE NATIONAL FUEL GAS CODE (ANSI/NFPA 54). FAILURE TO REPLACE THE ORIFICES WILL RESULT IN IMPROPER AND INEFFICIENT OPERATION OF THE APPLIANCE, PRODUCING CARBON MONOXIDE GAS IN EXCESS OF SAFE LIMITS, WHICH COULD RESULT IN SERIOUS PERSONAL INJURY OR DEATH.

GENESIS BOILERS ARE EQUIPPED WITH SELF-REGULATING PREJET ORIFICES WHICH AUTOMATICALLY COMPENSATE FOR HIGHER ELEVATIONS AND ADJUST THE APPLIANCE'S INPUT RATE ACCORDINGLY, MAKING IT UNNECESSARY TO REPLACE ORIFICES FOR HIGH ALTITUDE (UP TO 4,500 FEET). CONSULT THE FACTORY FOR HIGHER ALTITUDES.

Some utility companies derate their gas for altitude. You should contact your gas supplier for any specific changes which may be required in your area. Call the local gas utility to verify BTU content of the gas supplied.

Input rating specified on the rating plate applies to elevations up to 4,500 feet (1350 m). For elevations above 4,500 feet (1350 m), ratings must be reduced by a rate of 4% for each 1,000 feet (300 m) above sea level.

Example: A Genesis boiler is rated at 1,300,000 Btu/hr. input at sea level. At an altitude of 5,000 (1500 m), the prejet orifices will decrease the input rate by 20% (= 4% x 5) to a new rating of 1,040,000 Btu/hr. (= 80% x 1,300,000 Btu/hr.) The input reduction is achieved by the prejet orifices through self-regulation.

For installation locations with elevations above 4,500 feet (1350 m), consult the factory.

FEATURES/CONTROLS

MULTI-STAGE FIRING AND CONTROL SYSTEM

ALL MODELS - The control system consists of four basic components: 1) Central Control Board 2) Ignition Control Board 3) Display Board 4) Interface Board; see Figures 14-17. The Central Control Board, Ignition Control Boards and the Interface Board are located in the control box and can be accessed through panels on the left side and top of the unit. The Display Board is attached to the front jacket panel. The control system is a multi-stage control capable of managing three or four ignition stages. Three stage models include the 1000, 1300 and 1500. Four stage models include the 1850, 2100 and 2500. Every system will have one Central Control Board, one Interface Board, one Display Board and either three or four Ignition Control Boards depending on the model. There will be one Ignition Control Board per stage.

The Central Control Board, Figure 14, contains a strip of dip switches which allow the user to control several system variables. Table 5 shows a summary of these options. **The dip switches must be in the appropriate position for the unit's application.** Consult the Control System section of the manual for more information; see page 26.

TABLE 5. SUMMARY OF DIP SWITCH OPTIONS.

DIP SWITCH CONFIGURATION GUIDELINES			
SW1	**OFF**	**ON**	**SELECTION:**
A	3 STAGE	4 STAGE	EITHER 3 OR 4 STAGE SYSTEM
B	3 TRIALS	1 TRIAL	EITHER 3 OR 1
C	NO IRI GAS VALVE	IRI GAS VALVE	WHETHER SYSTEM IS IRI OR STANDARD
D	INLET	TANK	INLET OR TANK AS CONTROLLING PROBE
E	NO EXTERNAL THERMOSTAT	EXTERNAL THERMOSTAT	WHETHER EXTERNAL THERMOSTAT IS USED
F	OUTLET 210°F	OUTLET 240°F	OUTLET MAXIMUM TEMPERATURE
G	190°F	220°F	MAX. SET-POINT TEMPERATURE
H	DEGREES °F	DEGREES °C	EITHER °F OR °C FOR DISPLAYED TEMPERATURE

DIFFERENTIAL PRESSURE SWITCH

The differential pressure switch ensures that a sufficient differential exists between the air pressure in the pre-mix chamber and the inlet of the burner for safe, low NOX combustion. The switch has two pressure taps marked "+" (positive) and "-" (negative). Silicone tubing is run from the positive pressure tap of the switch to a tap on the control panel to measure the air pressure in the pre-mix chamber. The negative pressure tap measures the pressure taken at the burner's auxiliary tube. Connections can be seen by removing the lower front jacket panel. It is important that this panel remain sealed at all times while the boiler is operating.

The differential pressure switch is normally open and closes when the combustion blower starts.

BLOCKED FLUE PRESSURE SWITCH

The blocked flue pressure switch ensures that the flue gas vent is clear. This pressure switch is normally closed and only opens on the fault conditions.

FLAME SENSOR

The flame sensor acts to prove the flame has carried over from the ignitor to the right-most burner. If no flame is sensed, the gas valve(s) will close automatically. If no flame is sensed on three ignition trials the boiler will lock out. In the event of a lockout, depress the ENTER/RESET button on the display board to restart the boiler.

WATER FLOW SWITCH

The water flow switch is installed at the boiler outlet to prevent burner operation in the event of inadequate water flow through the boiler. It is a single pole, normally open switch that will close its contacts when increasing water flow rate is encountered. The water flow switch is factory-set, but may require field adjustment. The contacts will open when the flow rate drops below the adjusted setting causing the gas valve(s) to close which will turn off the gas to the burners.

LIMIT CONTROLS

CAUTION

LIMIT CONTROLS ARE SAFETY DEVICES AND ARE NOT TO BE USED AS A THERMOSTAT.

The G(B/W) models incorporate an outlet water probe consisting of two limit controls:

1. An adjustable automatic reset limit control, that can be set to either 210°F (99°C) or 240°F (115°C) depending on the application.

2. A fixed manual reset limit (ECO) factory set at 250°F (121°C). If the manual reset should open due to high temperature, the gas valves will close and the unit will go into lockout.

If lockout occurs, manually push the ENTER/RESET button on the Display Board to restart the boiler.

ON/OFF SWITCH

The ON/OFF switch is a single-pole, single-throw rocker switch. The switch provides 120VAC from the line source to the boiler.

COMBUSTION AIR BLOWER

Provides air for combustion process. The blower settings are adjustable through the use of the air shutter, however, blowers are set at the factory and should not need adjustment.

TANK PROBE

FOR HOT WATER SUPPLY SYSTEMS (GW models), a tank probe is supplied with each hot water supply boiler. The inlet water temperature will default to the tank temperature on the display when the tank probe is installed.

Note: The tank probe must be designated as the controlling probe using dip switch "D" on Central Control Board (Figure 14) before it can be used for (GW) hot water supply applications.

"Pigtails" of field-supplied wires should be spliced to "pigtails" of tank probe and connected to terminal block in the 24VAC junction box. See Figure 11 for the tank probe installation. Follow the instructions in the "Procedure for Settings Tank Probe Temperature"; see page 30.

FOR HOT WATER HEATING SYSTEMS (GB models), a tank probe is not supplied with the GB models due to the many various types of systems and operating conditions. A tank probe can be used as an option to control loop temperature and unit staging. Additionally, the inlet temperature probe can be used as the loop thermostat in some heating (GB) applications. The tank probe connects to designated wires in the junction box at the rear of the boiler. **Do not operate this boiler using the internal high limits only, use a tank probe or operating thermostat to control system temperatures.**

Note: The tank probe or additional 24VAC devices must be identified using Dip Switches on Central Control Board before they are recognized as a part of the heating system; see Table 5. Refer to "Multi-Stage Firing and Control System" section on previous page for more information about dip switch settings.

CIRCULATING PUMP

The pump flow rate should not exceed the maximum recommended flow rate; see Table 4.

FOR HOT WATER SUPPLY SYSTEMS (GW models), ordered with the circulator as an integral part of the boiler; the pump has been lubricated at the factory, and future lubrication should be in accordance with the motor manufacturer's instructions provided as supplement to this manual.

FOR HOT WATER HEATING SYSTEMS (GB models or GW models ordered without circulator), the circulator is NOT provided and must be field-installed.

LOW WATER CUTOFF (Not Supplied)

If low water protection is required by the authorities having jurisdiction, a low water cutoff switch should be installed next to the boiler in the outlet water line as shown in "HYDRONIC INSTALLATION" section; see page 15. The switch should receive periodic (every six months) inspection to assure proper operation. A low water cutoff device of the float type should be flushed every six months.

DRAIN VALVE (Not Supplied)

Additional drain valves must be obtained and installed on each boiler and tank for draining purposes.

SAFETY RELIEF VALVES

Your local code authority may have other specific relief valve requirements not covered below.

⚠ WARNING

THE PURPOSE OF A SAFETY RELIEF VALVE IS TO AVOID EXCESSIVE PRESSURE WHICH MAY CAUSE TANK EXPLOSION, SYSTEM OR BOILER DAMAGE.

TO AVOID WATER DAMAGE A DRAIN LINE MUST BE CONNECTED TO A SAFETY RELIEF VALVE FOR DIRECT DISCHARGE TO A SAFE LOCATION. A DRAIN LINE MUST NOT BE REDUCED FROM THE SIZE OF THE VALVE OUTLET AND IT MUST NOT CONTAIN ANY VALVES BETWEEN THE BOILER AND THE RELIEF VALVE OR THE RELIEF VALVE AND THE DRAIN EXIT. IN ADDITION, THERE SHOULD NOT BE ANY RESTRICTIONS IN A DRAIN LINE NOR SHOULD IT BE ROUTED THROUGH AREAS WHERE FREEZING CONDITIONS MIGHT OCCUR. DO NOT THREAD OR CAP THE DRAIN LINE EXIT. RESTRICTING OR BLOCKING A DRAIN LINE WILL DEFEAT THE PURPOSE OF THE RELIEF VALVE AND MAY CREATE AN UNSAFE CONDITION. INSTALL A DRAIN LINE WITH A DOWNWARD SLOPE SUCH THAT IT NATURALLY DRAINS ITSELF.

If any safety relief valve is replaced, the replacement valve must comply with the latest version of the ASME Boiler and Pressure Vessel Code, Section IV (HEATING BOILERS). Select a relief valve with a discharge rating NOT less than the boiler input, and a set pressure NOT exceeding the working pressure of any component in the system.

The storage tank temperature and pressure relief valve must comply with the applicable construction provisions of the Standard for Relief Valves and Automatic Gas Shut-off Devices for Hot Water Supply Systems, ANSI Z21.22 or CSA-4.4 (and latest addendums). The valve must be of the automatic reset type and not embody a single-use type fusible plug, cartridge or linkage.

FOR HOT WATER HEATING SYSTEMS, the boilers are shipped with a 50 psi pressure relief valve. This relief valve is factory installed in the water outlet header of the boiler; see Figure 1.

FOR HOT WATER SUPPLY SYSTEMS, the boilers are shipped with a 125 psi pressure relief valve. This relief valve is factory installed in the water outlet header of the boiler; see Figure 1.

This ASME-rated valve has a discharge capacity that exceeds the maximum boiler input rating and a pressure rating that does not exceed the maximum working pressure shown on the boiler rating plate.

In addition, a CSA design-certified and ASME-rated temperature and pressure (T & P) relief valve must be installed on each and every water storage tank in the hot water supply system; see Figures 10 and 12.

The T & P relief valve should have a temperature rating of 210°F (99°C), a pressure rating NOT exceeding the lowest rated working pressure of any system component, and a discharge capacity exceeding the total input of the water boilers supplying water to the storage tank.

Locate the T & P relief valve (a) in the top of the tank, or (b) in the side of the tank on a center line within the upper six (6) inches (15 cm) of the top of the tank. The tapping shall be threaded in accordance with the latest edition of the Standard for Pipe Threads, General Purpose (inch), ANSI/ASME B1.20.1. The location of, or intended location for, the T & P relief valve shall be readily accessible for servicing or replacement.

INSTALLATION INSTRUCTIONS

REQUIRED ABILITY

INSTALLATION OR SERVICE OF THIS BOILER REQUIRES ABILITY EQUIVALENT TO THAT OF A LICENSED TRADESMAN IN THE FIELD INVOLVED. PLUMBING, AIR SUPPLY, VENTING, GAS SUPPLY AND ELECTRICAL WORK ARE REQUIRED.

LOCATION

When installing the boiler, consideration must be given to proper location. The location selected should be as close to the stack or chimney as practical with adequate air supply and as centralized with the piping system as possible. The location should also be such that the gas ignition system components are protected from water (dripping, spraying, etc.) during appliance operation and service (circulator replacement, control replacement, etc.)

- THE BOILER MUST NOT BE INSTALLED ON CARPETING.
- THE BOILER SHOULD NOT BE LOCATED IN AN AREA WHERE IT WILL BE SUBJECT TO FREEZING.
- THE BOILER SHOULD BE LOCATED NEAR A FLOOR DRAIN.
- THE BOILER SHOULD BE LOCATED IN AN AREA WHERE LEAKAGE FROM THE BOILER OR CONNECTIONS WILL NOT RESULT IN DAMAGE TO THE ADJACENT AREA OR TO LOWER FLOORS OF THE STRUCTURE.

WHEN SUCH LOCATIONS CANNOT BE AVOIDED, A SUITABLE DRAIN PAN SHOULD BE INSTALLED UNDER THE BOILER. Such pans should be fabricated with sides at least 2-1/2" (6.5 cm) deep, with length and width at least 2" (5.1 cm) greater than the dimensions of the boiler and must be piped to an adequate drain. The pan must not restrict combustion air flow.

⚠ WARNING

THERE IS A RISK IN USING FUEL BURNING APPLIANCES IN ROOMS OR AREAS WHERE GASOLINE, OTHER FLAMMABLE LIQUIDS OR ENGINE DRIVEN EQUIPMENT OR VEHICLES ARE

STORED, OPERATED OR REPAIRED. FLAMMABLE VAPORS ARE HEAVY AND TRAVEL ALONG THE FLOOR AND MAY BE IGNITED BY THE IGNITER OR MAIN BURNER FLAMES CAUSING FIRE OR EXPLOSION. SOME LOCAL CODES PERMIT OPERATION OF GAS APPLIANCES IF INSTALLED 18 INCHES (46.0 CM) OR MORE ABOVE THE FLOOR. THIS MAY REDUCE THE RISK IF LOCATION IN SUCH AN AREA CANNOT BE AVOIDED.

FLAMMABLE ITEMS, PRESSURIZED CONTAINERS OR ANY OTHER POTENTIAL FIRE HAZARDOUS ARTICLES MUST NEVER BE PLACED ON OR ADJACENT TO THE BOILER.

OPEN CONTAINERS OF FLAMMABLE MATERIAL SHOULD NOT BE STORED OR USED IN THE SAME ROOM WITH THE BOILER.

A hot water boiler installed above radiation level or as required by the authority having jurisdiction, must be provided with a low water cutoff device either as a part of the boiler or at the time of boiler installation.

⚠ WARNING

UNDER NO CIRCUMSTANCES SHOULD THE EQUIPMENT ROOM WHERE THE BOILER IS INSTALLED EVER BE UNDER NEGATIVE PRESSURE. PARTICULAR CARE MUST BE TAKEN WHEN EXHAUST FANS, COMPRESSORS, AIR HANDLING EQUIPMENT, ETC., MAY INTERFERE WITH THE COMBUSTION AND VENTILATION AIR SUPPLIES OF THIS BOILER.

CHEMICAL VAPOR CORROSION

Heat exchanger corrosion and component failure can be caused by the heating and breakdown of airborne chemical vapors. Spray can propellants, cleaning solvents, refrigerator and air conditioning refrigerants, swimming pool chemicals, calcium and sodium chloride, waxes, and process chemicals are typical compounds which are corrosive. These materials are corrosive at very low concentration levels with little or no odor to reveal their presence.

Products of this sort should not be stored near the boiler. Also, air which is brought in contact with the boiler should not contain any of these chemicals. If necessary, uncontaminated air should be obtained from remote or outside sources. **Failure to observe this requirement will void the warranty.**

INSTALLATION CLEARANCES

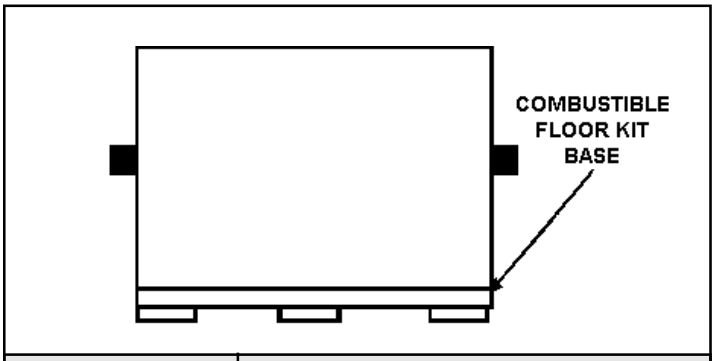
Sufficient area should be provided at the front and sides of the unit for proper servicing. For ease of service, minimum clearances of 24" (61.0 cm) in the front and 18" (46.0 cm) on the sides are recommended. It is important that the minimum clearances be observed to allow service to the control box and other controls. Observing proper clearances will allow service to be performed without movement or removal of the boiler from its installed location. Failure to observe minimum clearances may require removal of the boiler in order to service such items as the heat exchanger and burners. In a utility room installation, the door shall be wide enough to allow the boiler to enter or to permit the replacement of another appliance.

Two inch (5.1 cm) clearance is allowable from combustible construction to hot water pipes. Sufficient clearance should be provided at one end of the boiler to permit access to heat exchanger tubes for cleaning.

Access to control box items such as the Central Control Board, Ignition Control Boards, Interface Board and wiring harnesses is provided through a panel on the left side of the unit. A minimum service clearance of 18" (46.0 cm) is required.

These boilers are approved for installation on noncombustible flooring in an alcove with minimum clearance to combustibles of: 3 inches (7.6 cm) Right Side, and Back; 6 inches (15.2 cm) Top; Front, Alcove; 12 inches (30.5 cm) Left Side; and 6 inches (15.2 cm) surrounding the Vent.

For installation on combustible flooring use the Combustible Floor Kit. The combustible floor kit base adds 4" (10.1 cm) to the overall height of the boiler; see Figure 2.



MODEL	COMBUSTIBLE BASE KIT NUMBER
G(B,W) - 1000	211093
G(B,W) - 1300	211093-1
G(B,W) - 1500	211093-2
G(B,W) - 1850	211093-3
G(B,W) - 2100	211093-4
G(B,W) - 2500	211093-5

Figure 2. Boiler on Combustible Floor Base and Kit Numbers.

LEVELLING

Each unit must be checked after installation to be certain that it is level.

AIR REQUIREMENTS

⚠ WARNING

FOR SAFE OPERATION, AN AMPLE SUPPLY OF AIR MUST BE PROVIDED FOR PROPER COMBUSTION AND VENTILATION IN ACCORDANCE WITH THE NATIONAL FUEL GAS CODE, ANSI Z223.1 OR CAN/CSA-B149.1 AND .2 (LATEST EDITIONS) OR APPLICABLE PROVISIONS OF THE LOCAL BUILDING CODES. AN INSUFFICIENT SUPPLY OF AIR MAY RESULT IN A YELLOW, LUMINOUS BURNER FLAME, CARBONING OR SOOTING OF THE FINNED HEAT EXCHANGER, OR CREATE A RISK OF ASPHYXIATION. DO NOT OBSTRUCT THE FLOW OF COMBUSTION AND VENTILATION AIR.

UNCONFINED SPACE

In buildings of conventional frame, brick or stone construction, unconfined spaces may provide adequate air for combustion.

If the unconfined space is within a building of tight construction (buildings using the following construction: weather stripping, heavy insulation, caulking, vapor barrier, etc.), air for combustion, ventilation, must be obtained from outdoors or spaces freely communicating with the outdoors. The installation instructions for confined spaces in tightly constructed buildings must be followed to ensure adequate air supply.

CONFINED SPACE

(a) U. S. INSTALLATIONS

When drawing combustion and dilution air from inside a conventionally constructed building to a confined space, such a space shall be provided with two permanent openings, ONE WITHIN 12 INCHES OF THE ENCLOSURE TOP AND ONE WITHIN 12 INCHES OF THE ENCLOSURE BOTTOM. Each opening shall have a free area of at least one square inch per 1000 Btuh (2,203 mm^2/KW) of the total input of all appliances in the enclosure, but not less than 100 square inches.

If the confined space is within a building of tight construction, air for combustion, ventilation, and draft hood dilution must be obtained from outdoors. When directly communicating with the outdoors or communicating with the outdoors through vertical ducts, two permanent openings, located in the above manner, shall be provided. Each opening shall have a free area of not less than one square inch per 4000 Btuh (551 mm^2/KW) of the total input of all appliances in the enclosure. If horizontal ducts are used, each opening shall have a free area of not less than one square inch per 2000 Btuh (1,102 mm^2/KW) of the total input of all appliances in the enclosure.

(b) CANADIAN INSTALLATIONS

Ventilation of the space occupied by the boiler(s) shall be provided by an opening for ventilation air at the highest practical point communicating with outdoors. The total cross-sectional area shall be at least 10% of the area of the combustion air opening but in no case shall the cross-sectional area be less than 10 square inches (6500 mm^2).

In addition to the above, there shall be permanent air supply opening(s) having a cross-sectional area of not less than 1 square inch per 7,000 BTUH (315 mm^2/KW) up to and including 1,000,000 BTUH plus 1 square inch per 14,000 BTU (158 mm^2/KW) in excess of 1,000,000 BTUH. This opening(s) shall be located at, or ducted to, a point neither more than 18" (46.0 cm) nor less than 6 inches (15.2 cm) above the floor level.

Where power vented equipment is used in the same room as the boiler, sufficient air openings must be supplied. UNDERSIZED OPENINGS MAY RESULT IN INSUFFICIENT AIR FOR COMBUSTION.

Where an exhaust fan is installed in the same room with a boiler, sufficient openings for air must be provided in the walls. UNDERSIZED OPENINGS WILL CAUSE AIR TO BE DRAWN INTO THE ROOM THROUGH THE CHIMNEY, CAUSING POOR COMBUSTION. SOOTING MAY RESULT WITH AN INCREASED RISK OF ASPHYXIATION.

VENTING

⚠ CAUTION

WHEN VENTING THE GENESIS BOILER THROUGH AN OVERSIZED CHIMNEY (INCLUDING MASONRY CHIMNEYS), ADDITIONAL CARE MUST BE EXERCISED TO ASSURE PROPER DRAFT. FOR PROPER OPERATION, A MINIMUM DRAFT OF -0.02" W.C. AND A MAXIMUM DRAFT OF -0.04" W.C. MUST BE MAINTAINED. IN INSTANCES OF EXCESSIVE DRAFT, A BAROMETRIC DAMPER MAY BE REQUIRED TO ASSIST IN MAINTAINING THE PROPER DRAFT. DRAFT SHOULD BE MEASURED 2 FEET (0.6 M) ABOVE THE BOILER VENT COLLAR.

⚠ WARNING

THE INSTRUCTIONS IN THIS SECTION ON VENTING THE BOILER MUST BE FOLLOWED TO AVOID CHOKED COMBUSTION OR RECIRCULATION OF FLUE GASES. SUCH CONDITIONS CAUSE SOOTING OR RISKS OF FIRE AND ASPHYXIATION.

This boiler is approved to be vented as a Category I, Category III (horizontal venting), or a Direct Vent appliance. The Horizontal and Direct Venting options require a special vent kit.

STANDARD (VERTICAL) VENTING, CATEGORY I

THIS BOILER MAY BE VENTED ACCORDING TO TABLE 10 (ALSO SEE FIGURE 5). AT LEAST TYPE B VENTING MUST BE USED WITH THE STANDARD VENTING OPTION (thru-the-roof) USING THE NATIONAL FUEL GAS CODE VENT TABLES.* TYPE B VENT PIPE CANNOT BE USED IF THE BOILER IS VENTED HORIZONTALLY OR AS A DIRECT VENT (SEE PAGES 12 THROUGH 14). ALL LOCAL UTILITY, STATE/ PROVINCIAL, REGULATIONS ON VENTING MUST BE FOLLOWED.

VENT SIZING, INSTALLATION AND TERMINATION SHALL BE IN ACCORDANCE WITH THE NATIONAL FUEL GAS CODE, ANSI Z223.1 OR CAN/CSA-B149.1 and .2 (AND LATEST ADDENDA).*

Vent connections must be made to an adequate stack or chimney and shall be in accordance with the National Fuel Gas Code, ANSI Z223.1 or CAN/CSA-B149.1and .2 (and latest addenda) or applicable provisions of the local building codes. Size and install proper size vent pipe; refer to Table 6.

Horizontal runs of vent pipe shall be securely supported by adequately placed (approximately every 4 feet [1.2 m]), noncombustible hangers suitable for the weight and design of the materials employed to prevent sagging and to maintain a minimum upward slope of 1/4" per foot (2 cm/m) from the boiler to the vent terminals. Dampers or other obstructions must not be installed in the vent. Be sure that the vent connector does not extend beyond the inside wall of the chimney.

TABLE 6: VENT CONNECTION

MODEL NUMBER	VENT CONNECTOR
G(B,W) 1000	10" (25.4 cm)
G(B,W) 1300	12" (30.5 cm)
G(B,W) 1500	12" (30.5 cm)
G(B,W) 1850	14" (35.6 cm)
G(B,W) 2100	14" (35.6 cm)
G(B,W) 2500	16" (40.6 cm)

For vent arrangements other than Table 10 and for proper boiler operation, a barometric damper is required to maintain draft between -0.02" W.C.. and -0.04" W.C. at 2 feet (0.6 m) above the boiler vent collar.

STANDARD (HORIZONTAL) VENTING, CATEGORY III

Vent sizing, installation and termination shall be in accordance with the NATIONAL FUEL GAS CODE, ANSI Z223.1 OR CAN/CSA-B149.1 AND .2 (LATEST EDITIONS). If applicable, all local, utility, state/provincial regulations on venting must be followed. See Table 11, Figure 6 for venting specifications. The exhaust vent pipe must be of a type listed for use with Category III gas burning heaters such as "Saf-T-Vent" manufactured by Heat-Fab Inc.

For Category III installations, it is important that the Installed vent be airtight. Please insure that all joints are sealed properly during installation. For Horizintal Vent Kit part numbers, see Table 7.

TABLE 7: HORIZONTAL VENT KITS.

HORIZONTAL VENT KIT	MODEL
211426	G(B,W) 1000
211426-1	G(B,W) 1300
211426-1	G(B,W) 1500
211426-2	G(B,W) 1850
211426-2	G(B,W) 2100
211426-3	G(B,W) 2500

DIRECT VENT VERTICAL AND HORIZONTAL VENTING

For direct vent applications, this boiler may be vented according to Tables 12 and 13; see Figures 7 and 8. For category III applications, the exhaust vent pipe must be special vent pipe listed for use with category III gas burning heaters such as "Saf-T-Vent" manufactured by Heat-Fab Inc. This vent system must be 100% sealed with a condensate trap located as close to the boiler as possible. When sizing exhaust piping and intake air piping, 90-degree elbows are equivalent to 10 feet (3.1 m) of straight pipe and 45-degree elbows are equal to 5 feet (1.5 m) of straight pipe.

The intake air piping can be PVC, CPVC, ABS or any suitable intake air piping that can be sealed. See Table 8 for Direct Vent Kit numbers.

TABLE 8: DIRECT VENT KITS.

HORIZONTAL DIRECT VENT KIT NO.	MODEL
211090	G(B,W) 1000
211090-1	G(B,W) 1300
211090-1	G(B,W) 1500
211090-4	G(B,W) 1850
211090-2	G(B,W) 2100
211090-3	G(B,W) 2500
VERTICAL DIRECT VENT KIT NO.	**MODEL**
211089	G(B,W) 1000
211089-1	G(B,W) 1300
211089-1	G(B,W) 1500
211089-4	G(B,W) 1850
211089-2	G(B,W) 2100
211089-3	G(B,W) 2500

Combustion air from outside the building ducted to boiler air inlet (Ducted Air Application) cannot be used in rooms with negative pressure. Air intake terminals can be purchased through A. O. Smith. Use the following part numbers for ordering:

G(B/W) 1000 191965-2
G(B/W) 1300, 1500, 1850 211336
G(B/W) 2100, 2500 211336-1

HORIZONTAL VENT INSTALLATION

This boiler can be vented through the rear of the cabinet with the use of the fluebox and vent adaptor. Any of the previous venting configurations can be installed with rear connections.

To change the unit to rear exhaust:

1. The vent collar and cover plates must be removed from the top and rear of the unit.
2. Trim the insulation from around the rear flue hole in the jacket and the fluebox. Support insulation from inside the fluebox to facilitate cutting. Use safety precautions such as gloves. Place the gasket and vent adaptor in the horizontal position. Place the gasket and flue plate in the vertical position as shown in Figure 3.

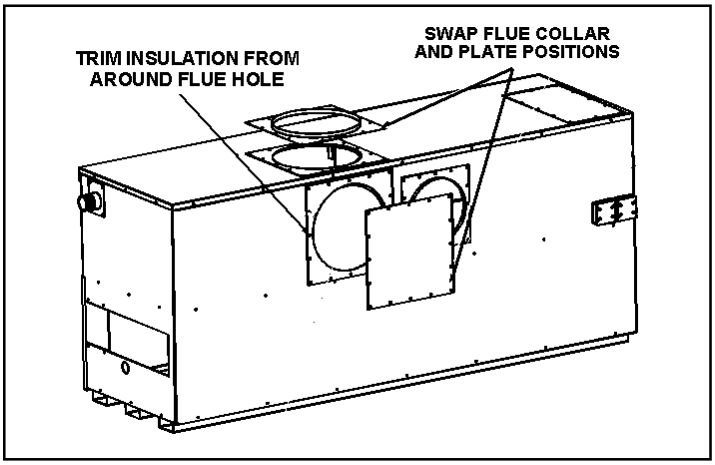


Figure 3. Switching from Vertical to Horizontal Venting.

POWER VENT (OPTIONAL)

The length of vent used in horizontally vented installations can be extended beyond the lengths shown in Tables 11 and 13 by implementing the kits listed below:

TABLE 9: POWER VENT KITS.

POWER VENT KIT NO.	MODEL	MAX. LENGTH
211499	G(B,W) 1000	110' (33.5 m)
211499-1	G(B,W) 1300	100' (30.5 m)
211499-1	G(B,W) 1500	100' (30.5 m)
211499-2	G(B,W) 1850	100' (30.5 m)
211499-3	G(B,W) 2100	100' (30.5 m)
211499-4	G(B,W) 2500	100' (30.5 m)

CONNECTING BOILER TO A COMMON VENT

Do not connect the boiler to a common vent or chimney with solid fuel burning equipment. This practice is prohibited by most local building codes as is the practice of venting gas fired equipment to the duct work of ventilation systems.

Where a separate vent connection is not available and the vent pipe from the boiler must be connected to a common vent with an oil burning furnace, the vent pipe should enter the common vent or chimney at a point ABOVE the flue pipe from the oil furnace.

UL/ULC listed double wall type B-1 gas vents, through 16" diameter, can be installed in heated and unheated areas and can pass through floors, ceilings, partitions, walls and roofs, provided the required clearance is observed.

At the time of removal of an existing boiler, the following steps shall be followed with each appliance remaining connected to the common venting system. Perform these steps while the other appliances remaining connected to the common venting system are not in operation.

1. Seal any unused opening in the common venting system.
2. Visually inspect the venting system for proper size and horizontal pitch and determine there is no blockage or restriction, leakage, corrosion or other unsafe condition.

3. Insofar as is practical, close all building doors, windows and all doors between the space in which the appliances remaining connected to the common venting system are located and other spaces of the building. Turn on clothes dryers and any appliance not connected to the common venting system. Turn on any exhaust fans, such as range hoods and bathroom exhausts, so they will operate at maximum speed. Do not operate a summer exhaust fan. Close fireplace dampers.

4. Test fire the appliance(s) being inspected, making sure to follow the manufacturers lighting and operating instructions. Appliance(s) operating controls should be adjusted to provide continuous service.

5. Check vent pressure of the appliance 24 inches (61.0 cm) above boiler vent collar. Vent pressure should be maintained between -0.02" W. C. and -0.04" W.C. to assure proper operation. For appliances with a draft hood, check for spillage with mirror, smoke or other device five minutes after placing appliance in operation.

6. After it has been determined that each appliance remaining connected to the common venting system properly vents when tested as outlined above, return doors, windows, exhaust fans, fireplace dampers and other gas burning appliances to their previous conditions of use.

All boiler venting systems shall be installed in accordance with the National Fuel Gas Code, ANSI Z223.1 or CAN/CSA-B149.1 and .2 (and latest addendums), or applicable provisions of the local building codes.

LOCATION REQUIREMENTS (INTAKE/EXHAUST)

1. The termination must be 12 inches (30.5 cm) above snow or grade level whichever is higher.

2. Due to normal formation of water vapor in the combustion process, horizontal terminations must not be located over areas of pedestrian or vehicular traffic, i.e. public walkways or over areas where condensate could create a nuisance or hazard. This is especially true in colder climates where ice buildup is likely to occur. A.O. Smith Corporation will not be held liable for any personal injury or property damage due to any dislodging of ice.

3. The exhaust terminal of the venting system must maintain a minimum clearance of 4 feet (1.22 m) horizontally from, and in no case above or below, unless a 4-foot horizontal distance is maintained, from electric meters, gas meters, regulators and relief equipment.

4. The minimum distance from inside corner formed by two exterior walls is 6 feet (1.8 m) but 10 feet (3.1 m) is recommended where possible.

5. Maintain a minimum distance of 4 feet (1.2 m) from any soffit or eve vent to the exhaust terminal.

6. Maintain a minimum distance of 10 feet (3.1 m) from any forced air inlet. Fresh air or make up air inlet such as a dryer or furnace area is considered to be a forced air inlet.

7. Avoid areas where condensate drainage may cause problems such as above planters, patios, or adjacent to windows where the steam from the flue gases may cause fogging.

8. Select the point of wall penetration where the minimum 1/4" per foot (2 cm/m) of slope up can be maintained.

9. The through the wall termination kit is suitable for zero clearance to combustible materials.

10. The mid point of the termination elbow must be a minimum of 12 inches (30.5 cm) from the exterior wall.

⚠ CAUTION

DIRECT VENTING INTO DEAD AIR SPACES SUCH AS ALLEYS, ATRIUMS AND INSIDE CORNERS CAN CAUSE RECIRCULATION OF FLUE GASES. RECIRCULATION OF FLUE GASES WILL CAUSE SOOTING, PREMATURE FAILURE OF THE HEAT EXCHANGER AND ICING OF THE COMBUSTION AIR INTAKE DURING SEVERE COLD WEATHER. TO PREVENT THE RECIRCULATION OF FLUE GASES, MAINTAIN AS MUCH DISTANCE AS POSSIBLE BETWEEN THE COMBUSTION AIR INTAKE AND THE EXHAUST VENT TERMINAL.

Note: Venting system of other than direct-vent appliance shall terminate at least 4 ft. (1.2 m) below, 4 ft. (1.2 m) horizontally from, or 1 ft. (30.0 cm) above any door window or gravity air inlet.

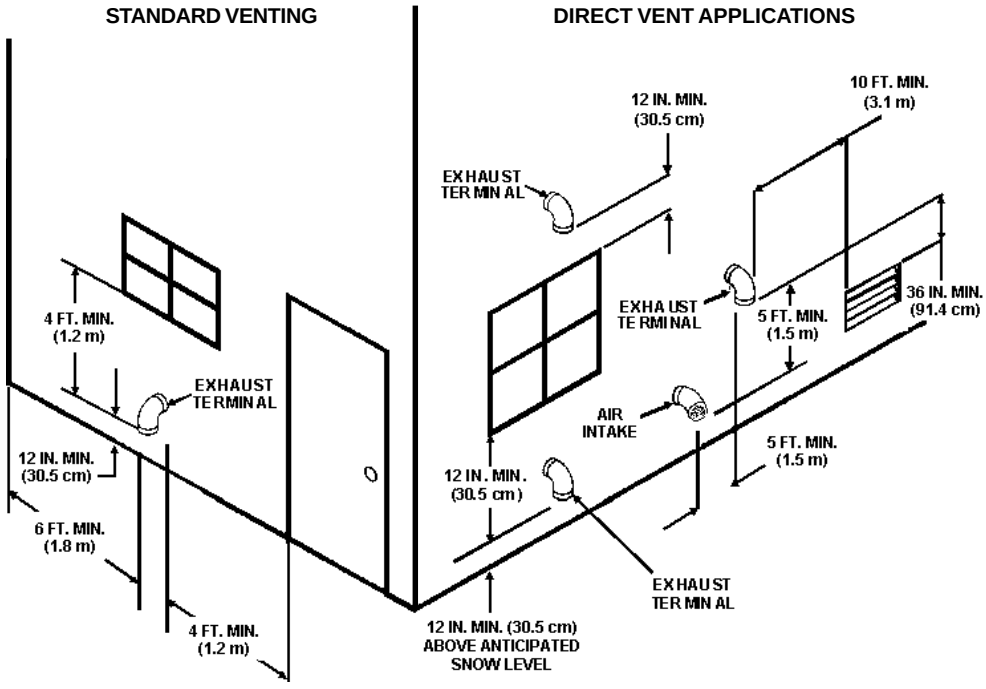
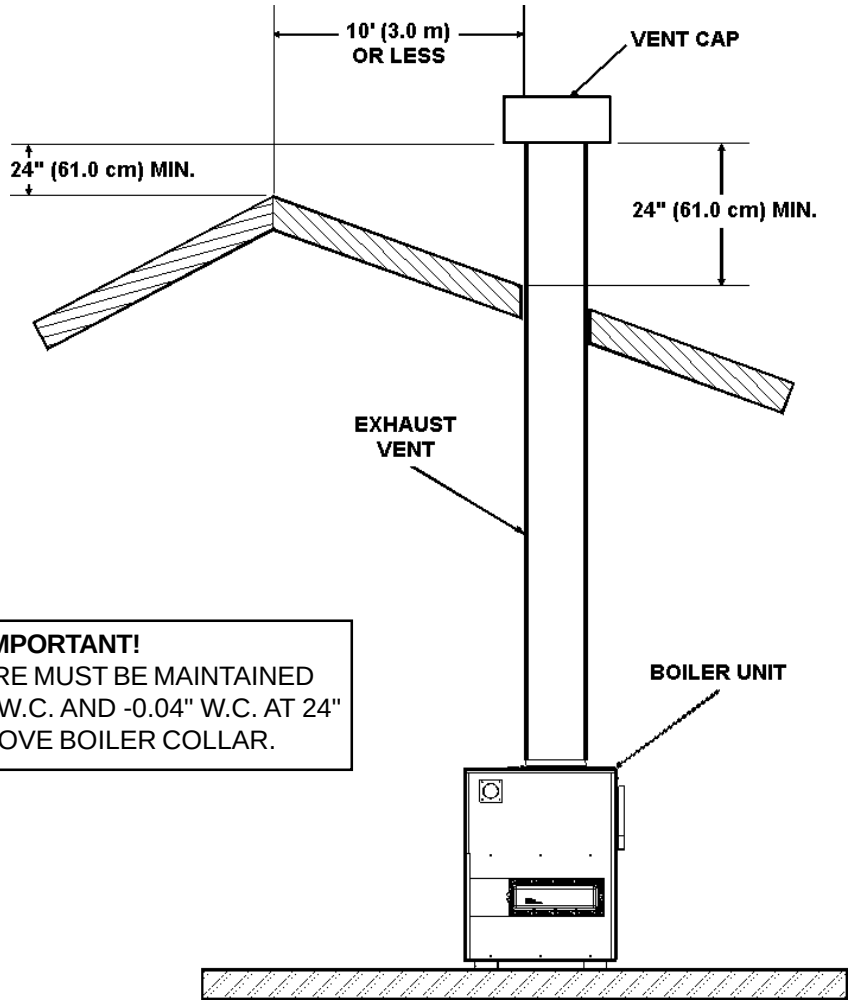


Figure 4. Vent Termination Installation Clearances

STANDARD VENT - VERTICAL (CATEGORY I)



IMPORTANT!
VENT PRESSURE MUST BE MAINTAINED BETWEEN -0.02" W.C. AND -0.04" W.C. AT 24" (61.0 cm) ABOVE BOILER COLLAR.

Figure 5.

TABLE 10. STANDARD VERTICAL VENTING (CATEGORY I)

MODEL	APPLIANCE CATEGORY	CERTIFIED VENTING MATERIAL	EXHAUST VENT SIZE INCHES (cm)	MAXIMUM LENGTH WITHOUT BAROMETRIC DAMPER FEET (m)
I000	I	TYPE B OR EQUIVALENT	10"(25.4 cm)	35 Feet (10.7 m) without damper *70 Feet (21.3 m) max. with damper
1300 1500	I	TYPE B OR EQUIVALENT	12" (30.5 cm)	35 Feet (10.7 m) without damper *70 Feet (21.3 m) max. with damper
1850 2100	I	TYPE B OR EQUIVALENT	14"(35.6 cm)	35 Feet (10.7 m) without damper *70 Feet (21.3 m) max. with damper
2500	I	TYPE B OR EQUIVALENT	16" (40.6 cm)	35 Feet (10.7 m) without damper *70 Feet (21.3 m) max. with damper

*** Extending venting over 70 feet (21.3 m) may require special considerations.**

• Connection for the appliance exhaust vent to the stack must be as direct as possible. Maximum and minimum venting length for Category I appliances shall be determined per the latest edition of the National Fuel Code (U.S.) and CAN/CSA-B149.1 and .2 Installation Code (Canada).

• The horizontal breaching of a vent must have an upward slope of not less than 1/4 inch per linear foot (2 cm/m) from the boiler to the vent terminal. The horizontal portion of the vent shall be supported to maintain clearances and to prevent physical damage or separation of joints.

STANDARD VENT - HORIZONTAL (CATEGORY III)

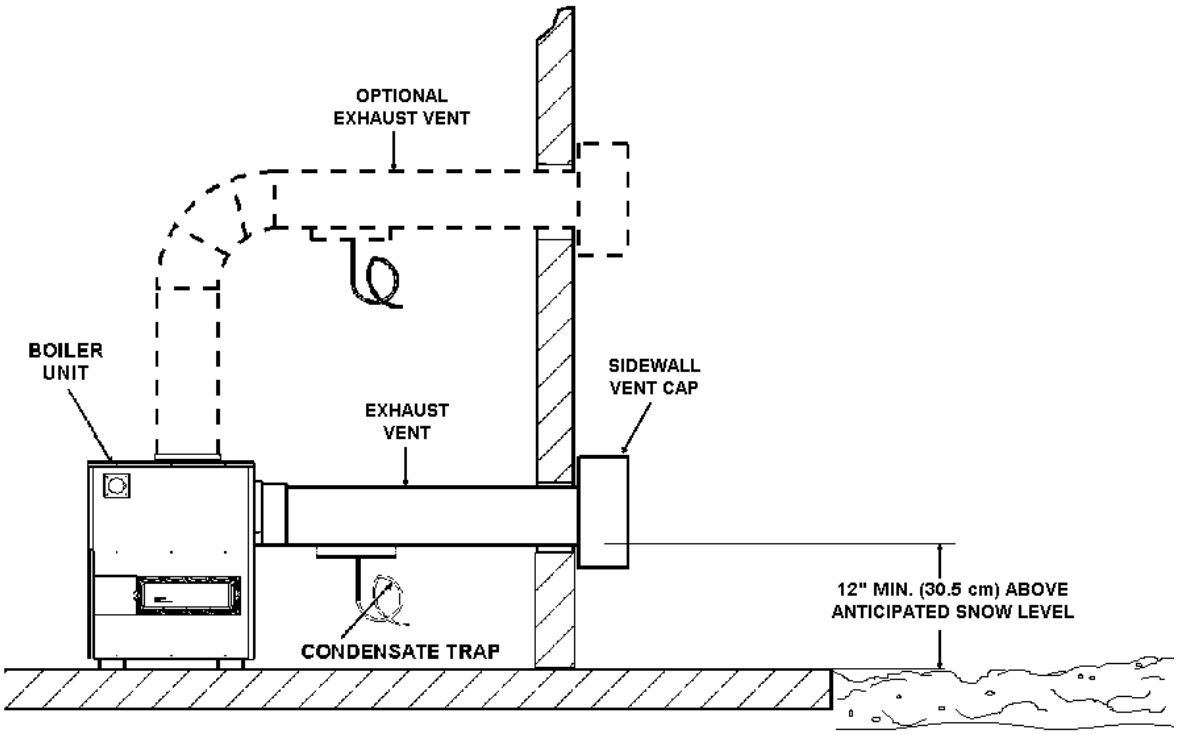


Figure 6.

TABLE 11. STANDARD HORIZONTAL VENTING (CATEGORY III)

MODEL	APPLIANCE CATEGORY	CERTIFIED VENTING MATERIAL	EXHAUST VENT SIZE INCHES (cm)	MAXIMUM VENT LENGTH FEET (m)
I000	III	STAINLESS STEEL	10”(25.4 cm)	70' (21.3 m)
1300 1500	III	STAINLESS STEEL	12" (30.5 cm)	70' (21.3 m)
1850 2100	III	STAINLESS STEEL	14"(35.6 cm)	70' (21.3 m)
2500	III	STAINLESS STEEL	16" (40.6 cm)	70' (21.3 m)

WARNING: No substitutions of flue pipe or vent cap material are allowed. Such substitutions would jeopardize the safety and health of inhabitants.

• A maximum of two elbows can be used on inlet and outlet vent piping respectively. Each elbow is equal to 10 feet (3 m) of straight pipe.

• Use only special gas vent pipes listed for use with Category III gas burning heaters, such as stainless steel Saf-T-Vent by Heat Fab, Inc., available from A.O. Smith WPC, 5621 W. 115th Street, Alsip, IL 60803 Phone: 1-800-433-2545 or Fax: 1-800-433-2515. Pipe joints must be positively sealed.

DIRECT VENT - VERTICAL (CATEGORY I)

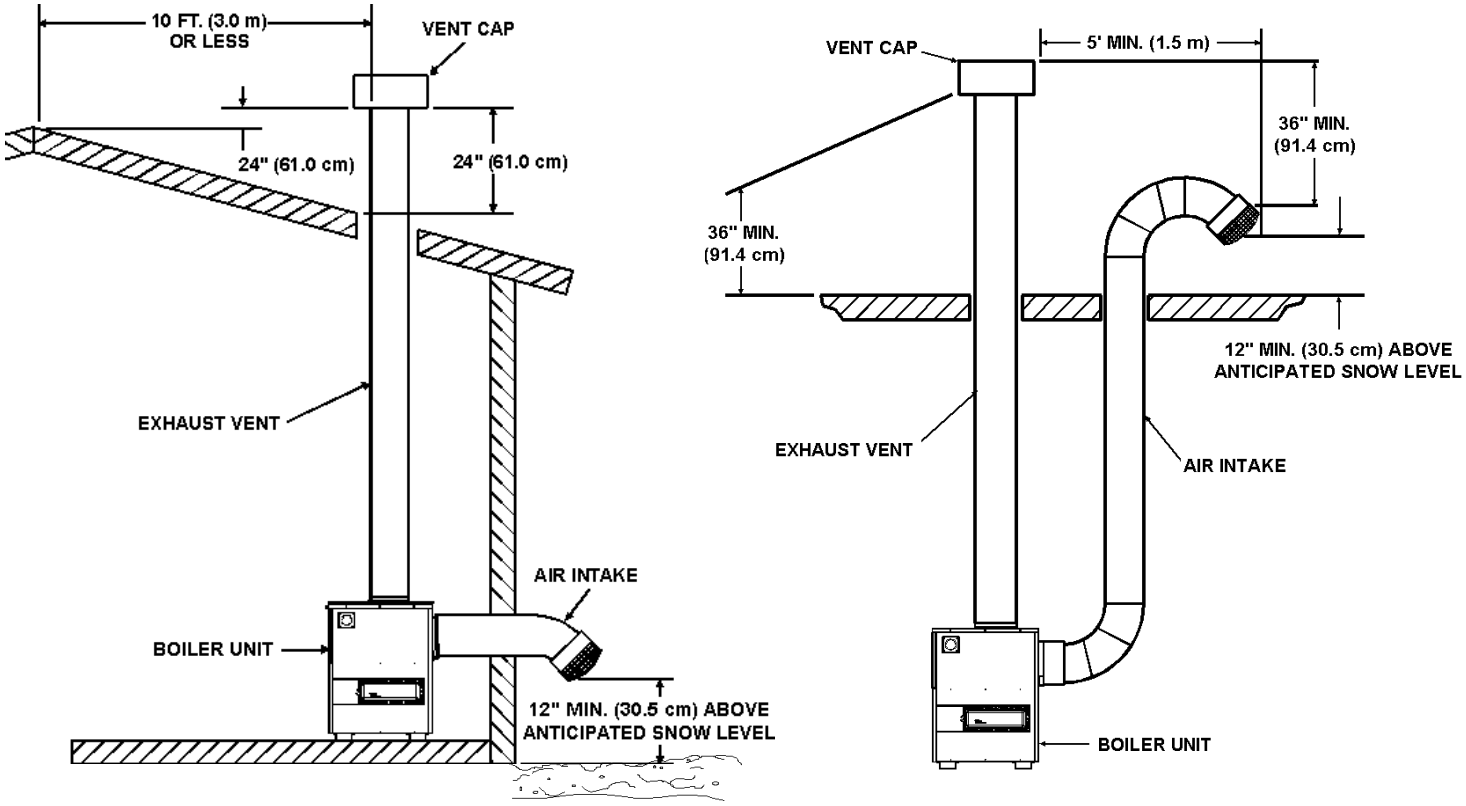


Figure 7.

TABLE 12. DIRECT VENT (VERTICAL EXHAUST CONFIGURATIONS)

MODEL	APPLIANCE CATEGORY	CERTIFIED EXHAUST VENT MATERIAL	EXHAUST VENT SIZE INCHES (cm)	MAXIMUM EXHAUST VENT LENGTH FT (m)	AIR INTAKE MATERIAL	AIR INTAKE SIZE INCHES (cm)	MAXIMUM AIR INTAKE LENGTH FT (m)
I000	I	TYPE B OR EQUIVALENT	10" (25.4 cm)	35' (10.7 m)	GAL. STEEL PVC, ABS OR CPVC	8" (20.3 cm)	35' (10.7 m)
1300 1500	I	TYPE B OR EQUIVALENT	12" (30.5 cm)	35' (10.7 m)	GAL.STEEL PVC, ABS CR CPVC	10" (25.4 cm)	35' (10.7 m)
1850	I	TYPE B OR EQUIVALENT	14" (35.6 cm)	20' (6.1 m)	GAL. STEEL PVC, ABS OR CPVC	10" (25.4 cm)	20' (6.1 m)
2100	I	TYPE B OR EQUIVALENT	14" (35.6 cm)	20' (6.1 m)	GAL. STEEL PVC, ABS OR CPVC	12" (30.5 cm)	20' (6.1 m)
2500	I	TYPE B OR EQUIVALENT	16" (40.6 cm)	20' (6.1 m)	GAL. STEEL PVC, ABS OR CPVC	12" (30.5 cm)	20' (6.1 m)

• Connection for the appliance exhaust vent to the stack must be as direct as possible. Maximum and minimum venting length for Category I appliances shall be determined per the latest edition of the National Fuel Code (U.S.) and CAN/CSA-B149.1 and .2 Installation Code (Canada).

• The vent should be installed so as to prevent the accumulation of condensate and, where necessary, have means provided for drainage of condensate. The horizontal breaching of a vent must have an upward slope of not less than 1/4 inch per linear foot (2 cm/m) from the boiler to the vent terminal. The horizontal portion of the vent shall be supported to maintain clearances and to prevent physical damage or separation of joints.

DIRECT VENT - HORIZONTAL (CATEGORY III)

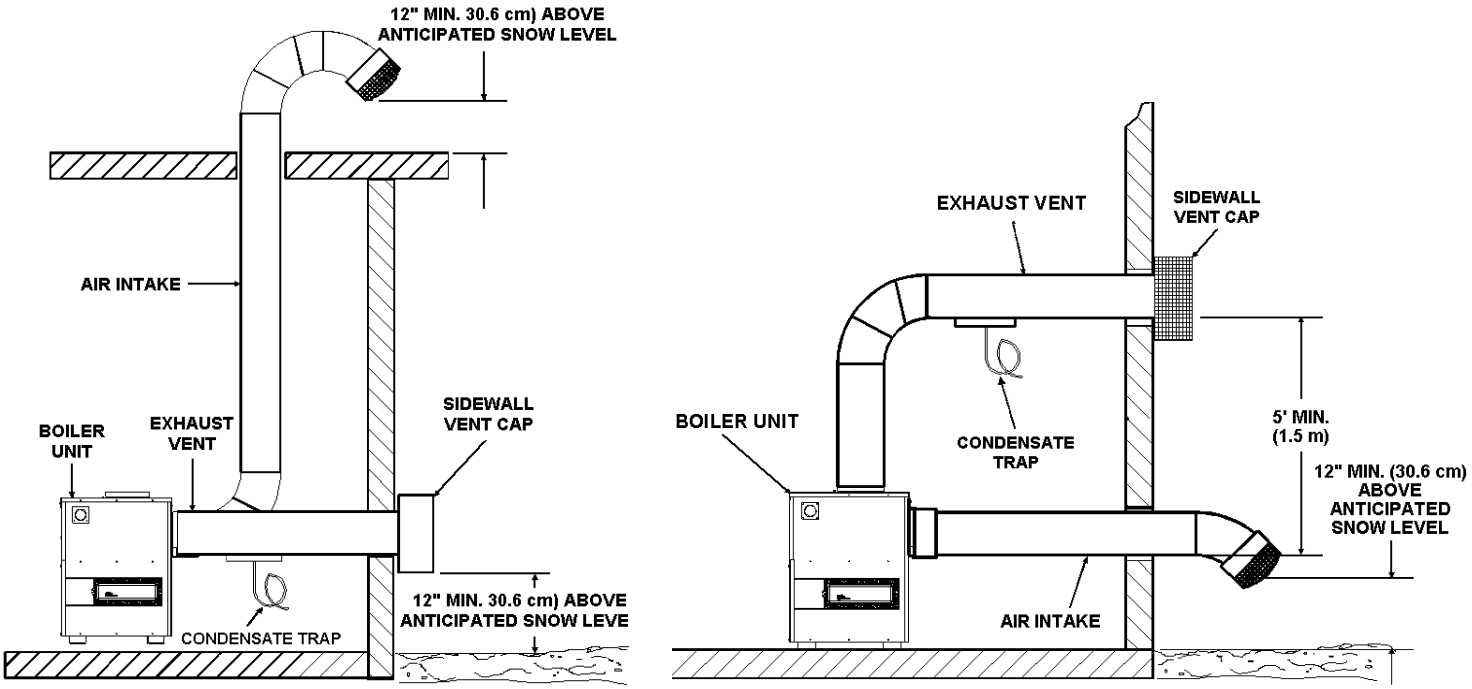


Figure 8.

TABLE 13. DIRECT VENT (HORIZONTAL EXHAUST CONFIGURATIONS)

MODEL	APPLIANCE CATEGORY	CERTIFIED EXHAUST VENT MATERIAL	EXHAUST VENT SIZE INCHES (cm)	MAXIMUM EXHAUST VENT LENGTH FT (m)	AIR INTAKE MATERIAL	AIR INTAKE SIZE INCHES (m)	MAXIMUM AIR INTAKE LENGTH FT (m)
I000	III	STAINLESS (SEALED)	10" (25.4 cm)	35' (10.7 m)	GAL. STEEL PVC, ABS OR CPVC	8" (20.3 cm)	35' (10.7 m)
1300 1500	III	STAINLESS (SEALED)	12" (30.5 cm)	35' (10.7 m)	GAL.STEEL PVC, ABS CR CPVC	10" (25.4 cm)	35' (10.7 m)
1850	III	STAINLESS (SEALED)	14" (35.6 cm)	20' (6.1 m)	GAL. STEEL PVC, ABS OR CPVC	10" (25.4 cm)	20' (6.1 m)
2100	III	STAINLESS (SEALED)	14" (35.6 cm)	20' (6.1 m)	GAL. STEEL PVC, ABS OR CPVC	12" (30.5 cm)	20' (6.1 m)
2500	III	STAINLESS (SEALED)	16" (40.6 cm)	20' (6.1 m)	GAL. STEEL PVC, ABS OR CPVC	12" (30.5 cm)	20' (6.1 m)

WARNING: No substitutions of flue pipe or vent cap material are allowed. Such substitutions would jeopardize the safety and health of inhabitants.

• A maximum of two elbows can be used on inlet and outlet vent piping respectively. Each elbow is equal to 10 feet (3 m) of straight pipe.

• Use only special gas vent pipes listed for use with Category III gas burning heaters, such as stainless steel Saf-T-Vent by Heat Fab, Inc. Inc., available from A.O. Smith WPC, 5621 W. 115th Street, Alsip, IL 60803 Phone: 1-800-433-2545 or Fax: 1-800-433-2515. Pipe joints must be positively sealed.

SYSTEM INSTALLATION

GENERAL

If the system is to be filled with water for testing or other purposes during cold weather and before actual operation, care must be taken to prevent a down draft entering the boiler or freezing air from contacting the system. Failure to do so may cause the water in the system to freeze with resulting damage to the system. Damage due to freezing is not covered by the warranty.

Good practice requires that all piping, etc., be properly supported.

The boilers described in this manual may be used for space (hydronic) heating or for the heating of potable water. If the heater is to be used for hydronic space heating, follow the instructions on pages 15-17 given for equipment required for installation as in Figure 9. However, if units are to be used for heating potable water, the information describing specific systems is found on pages 17-19; see Figures 10 and 12. Installations must comply with all local codes.

INSTALLATION AS BOILER REPLACEMENT

Installation as boiler replacement on an old system with large water volume may result in condensation within the boiler on cold starts. This condensing of water vapor in the combustion area can be prevented if a portion of the system water flow is diverted past the boiler to cause an increase in boiler temperature.

BYPASS BALANCING

With systems where water temperature can be expected to drop appreciably due to long standby periods, or heavy draw down, a bypass pipe of at least 1" size with a balancing cock should be installed between the boiler inlet and outlet see Figure 9. When the system first starts, the valve should be slowly opened until the condensing ceases. This adjustment remains at a permanent setting to establish required temperature rise across the boiler.

AIR SEPARATOR

An air separator as shown in the piping diagram is recommended especially for modern commercial hydronic systems.

VENT VALVES

It is recommended that automatic, loose key or screwdriver type vent valves be installed at each convector or radiator.

SYSTEM HEADERS

Split systems with individual supply and return lines from the boiler room should normally have this piping connected to supply and return manifold headers near the boiler. To achieve good water distribution with minimum pressure drop for several circuits, manifolds should be larger than system loops.

The circuits should be spaced on the header at a minimum of 3" (7.6 cm) center to center. Install a balancing cock in each return line.

Manifold headers are recommended for split systems with or without zone valves and also those installations with zone circulators. If the system is to be split at remote points, good practice requires special attention be given to main pipe sizing to allow balancing of water flow.

COOLING PIPING

When the boiler is used in conjunction with a refrigeration system it must be installed so that the chilled medium is piped in parallel with the boiler. Appropriate valves, manual or motorized, must be provided to prevent the chilled medium from entering the boiler.

Water temperature in the heating system must be reduced to less than 100°F (38°C) before cooling system is started, or damage to the chiller unit may occur.

If the boiler is connected to chilled water piping or heating coils exposed to refrigerated air, the boiler piping system must be equipped with flow control valves or other automatic means to prevent gravity circulation through the boiler during the cooling cycle. Primary/secondary pumping of both the chiller(s) and the boiler(s) is an excellent winter-summer change-over method, because cooling flow rates are much more than heating flow rates. In this way each system (heating or cooling) is circulated independently.

EXPANSION TANK

Install an expansion tank as shown in Figures 10 and 12. The sizing of the expansion tank is very important and is directly related to the total water volume of the system. Refer to ASME or other reliable specifications for sizing.

HYDRONIC INSTALLATION

The following is a brief description of the equipment required for installations noted in this manual. All installations must comply with local codes; see Figure 9.

TABLE 14: INSTALLATION ITEMS

NO.	SUGGESTED ITEMS FOR INSTALLATION
1.	PAIR OF SHORT PIPE NIPPLES, PAIR OF BOILER LOOP TEES AND BALL VALVE BETWEEN SYSTEM SUPPLY AND RETURN - ONE SET PER EACH BOILER
2.	BOILER PIPE LOOP (See Sizing Data Table 4.)
3.	BOILER CIRCULATING PUMP (See Sizing Data Table 4.)
4.	THERMOMETER
5.	PRESSURE GAUGE
6.	LOW WATER CUTOFF (If Required By Local Code.)
7.	SAFETY FLOW SWITCH (Factory-Installed)
8.	RELIEF VALVE (Factory-Installed)
9.	BOILER INLET - OUTLET
10.	SYSTEM SUPPLY TEMPERATURE THERMOMETER
11.	DRAIN or BLOW-DOWN VALVE

WATER SUPPLY LINE

These boilers can be used ONLY in a forced circulation hot water heating system. The pump must be interlocked with the boiler to prevent boiler operation without water circulation. See maximum and minimum flow rate information. Since most forced circulation systems will be of the closed type, install the water supply line as shown on piping diagram; see Figure 9. **Severe damage will occur if the boiler is operated without proper water flow circulation.**

Fast filling of large pipe, old radiator installations (where high pressures are not available) requires bypassing of the pressure reducing valve. Generally, pressure purging is not possible with a well pump system. High point air venting is essential. For details, refer to OPERATION section of this manual on page 23.

If the system is of the open type, a pressure reducing valve will not be required as the water supply to the system will be controlled by a manually operated valve. An overhead surge tank is required. A MINIMUM PRESSURE OF 15 PSI (100 kPa) MUST BE MAINTAINED ON THE BOILER AT ALL TIMES to avoid potential damage to the boiler that may not be covered by the warranty.

CONVENTIONAL SPACE HEATING INSTALLATION

Modern fin type boilers are exceptionally fast heating units. The low water volumes in relation to firing rates require special attention to water flow rates for smooth, efficient operation. These considerations for the A. O. Smith copper heat exchanger boilers are covered below.

Refer to Table 4 showing flow rate vs. pressure drop and temperature rise.

Figure 9 shows a typical installation of the boiler.

A system with several flow controlled zones, or with a 3-way mixing valve system could present a flow rate to the boiler of less than required for a maximum of 50°F (28°C) temperature rise. Design system with compensating bypasses to the boiler.

A system bypass should be installed as shown in Figure 10 to prevent boiler circulation starvation when the system zones call for reduced flow.

This bypass may also be used with multiple boilers manifolded for reverse-return flow. The system bypass would be installed from boiler outlet to suction side of pump.

The boiler piping system of a hot water heating boiler connected to heating coils located in air handling units where they may be exposed to circulating refrigerated air, must be equipped with flow control valves or other automatic means to prevent gravity circulation of the boiler water during the cooling cycle. It is highly recommended that the piping be insulated.

SPACE HEATING APPLICATIONS

Controlling of these systems is decided mainly by the type of building system controlling that is desired. A single boiler installation might be controlled directly from space temperature thermostat(s). Multiple boiler installations are more effective when the boilers are sequenced in and out of operation by some form of main water temperature controller. With one or two boilers, individual control settings at progressive temperature may be used. For more than two boilers, electronic sequencing controlling is recommended.

Individual controls, or the separate stages of a step controller, should start the boiler loop circulator and fire the boiler. Some large installations may require the firing of more than one boiler per stage.

The system or primary circulator may or may not be controlled by the boiler sequencer. When this pump is operated through the first switch of any type of step controller, care should be taken to determine if a motor starter is needed due to insufficient switch capacity.

If the primary pump is controlled by a manual switch or any other controllers, the electric current supply to the boiler group should be through the primary pump controller. The fast response of A.O. Smith boilers eliminates any need to maintain boiler temperature when the system is satisfied. **Wiring should always prevent firing of boiler(s) when there is no water flow in the mains.**

Multiple boiler installations are especially adapted to the use of outdoor reset for main water temperatures. This feature is not mandatory but offers smooth, efficient operation of a modern system.

Normal use of flow control valves is required to prevent cross circulation of zones as with any multiple pump system.

Large systems with multiple boilers should include main water temperature controls (with or without outdoor reset) to sequence the boiler on and off, in relation to the load on the system.

24 VAC System Controller (Optional)

GB models require a field supplied 24VAC operating control to be installed in the system such as: loop thermostat, indoor/outdoor reset control, sequencing panel, or energy management system.

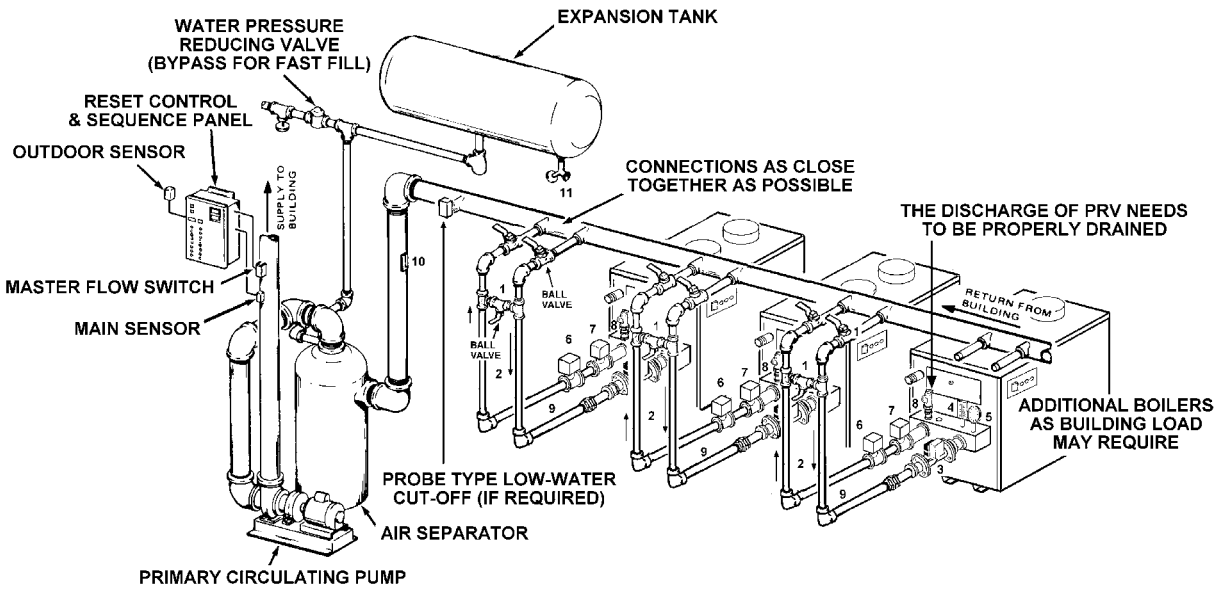


Figure 9. Single or Multiple Boiler Installation Diagram

The connection for such devices is located in the 24 VAC junction box at the rear of the unit. A 24 VAC thermostat/aquastat can only be used as an "On/Off" switch for the unit. The actual controlling of the staging will be through either the inlet or tank probe. To use a 24 VAC system controller, dip switch "E" on the CCB must be switched to the "on" position; see Figure 14.

INTERNAL CONTAMINANTS

The system must be internally cleaned and flushed after a new or replacement unit has been installed to remove contaminants that may have accumulated during installation. This is doubly important when a replacement unit is installed into an existing system where Stop Leak or other boiler additives have been used.

All systems should be completely flushed with a grease removing solution to assure trouble-free operation. Pipe joint compounds, soldering paste, grease on tubing and pipe all tend to contaminate a system.

Failure to clean and flush the system can cause solids to form on the inside of the heat exchanger, can produce acid concentrations that become corrosive, can allow excessive amounts of air or other gases to form which could block circulation, foul system accessories and damage circulator seals and impellers.

It is recommended that after installation, the boiler and system when filled should include the proper percentage of cleaning solution related to approximate water volume of the system. Fire and circulate for about one hour and then flush clean with fresh water. Commercial grease removing solutions are available.

Before operating the boiler, the entire system must be filled with water, purged of air and checked for leaks. Do not use Stop Leak or other boiler compounds. The gas piping must also be leak tested.

THE WATER HEATER SHOULD BE LOCATED IN AN AREA WHERE THE GENERAL PUBLIC DOES NOT HAVE ACCESS TO SET TEMPERATURES.

HOT WATER SUPPLY BOILER INSTALLATION

WATER LINE CONNECTIONS

Where excessive heat exchanger condensation exists due to continued low inlet water temperatures below 120°F (49°C), a bypass balance loop must be installed; see Figures 10 and 12.

HARD WATER CONDITIONS

Where hard water conditions exist, water softening or the threshold type of water treatment is recommended. This will protect the dishwashers, coffee urns, water heaters, water piping and other equipment. When water softening or water treatment is not practical, a comparatively easy method of periodic lime removal from the unit must be employed.

⚠ WARNING

LIME ACCUMULATION CAN REDUCE THE LIFE OF THE EQUIPMENT, REDUCE EFFICIENCY AND WASTE FUEL. BOILER FAILURE DUE TO LIME OR SCALE BUILDUP VOIDS THE WARRANTY.

Tank Probe (Optional)

In addition to the Inlet and Outlet/ECO Probes, units can be optionally equipped with a tank probe. The connection for the tank probe is located in the 24VAC junction box at the rear of the unit. The tank probe can be configured to control the staging of the unit. See "Tank Probe Installation Procedure" section below for additional information.

TANK PROBE INSTALLATION PROCEDURE

A tank probe is supplied with each hot water supply boiler (GW). To connect the tank probe to the boiler, remove the cover from the 24VAC junction box at the rear of the unit. Connect the probe wires across terminals 1 & 2. (The wires leading to the terminals will be yellow.) Check the field connection diagram located on this cover of the junction box to assure proper wiring.

Once the tank probe has been connected to the boiler, it must be designated as the controlling probe for the system. This is accomplished by changing two Dip Switch settings on the Central Control Board. First, Dip Switch "D" must be set to the "ON" position to designate the tank probe as the controlling probe. Second, Dip Switch "G" must be set to the "OFF" position to limit the maximum tank probe temperature for GW applications. It is also advisable to make sure Dip Switch "F" is set to the "OFF" position which sets the outlet temperature Set-Point to 210°F (99°C); see Figure 14. Failure to do this will void the warranty. If the tank probe is not designated as the controlling probe, the staging of the unit will be controlled by the inlet probe and will not use the desired tank temperature as its base. Once the tank probe is designated as the controlling probe, the inlet water temperature on the display will default to the tank temperature.

Refer to "Connection Diagram" Figure 20 in order to connect the tank probe to the boiler. Also refer to Figure 11.

See section titled "Procedures for Setting Tank Probe Temperature", on page 30 for instructions on how to set the temperature.

GAS CONNECTIONS

⚠ WARNING

THIS BOILER IS NOT INTENDED TO OPERATE AT GAS SUPPLY PRESSURE OTHER THAN SHOWN ON THE RATING PLATE. EXPOSURE TO HIGHER GAS SUPPLY PRESSURE MAY CAUSE DAMAGE TO GAS VALVES WHICH CAN RESULT IN FIRE OR EXPLOSION. IF OVERPRESSURE HAS OCCURRED SUCH AS THROUGH IMPROPER TESTING OF GAS LINES OR EMERGENCY MALFUNCTION OF THE SUPPLY SYSTEM, THE GAS VALVES MUST BE CHECKED FOR SAFE OPERATION. MAKE SURE THAT THE OUTSIDE VENTS ON THE SUPPLY REGULATORS AND THE SAFETY VENT VALVES ARE PROTECTED AGAINST BLOCKAGE. THESE ARE PARTS OF THE GAS SUPPLY SYSTEM, NOT THE BOILER. VENT BLOCKAGE MAY OCCUR DURING ICE BUILD-UP OR SNOW STORMS.

ONE GENESIS (MODEL GW) HOT WATER SUPPLY BOILER WITH HORIZONTAL TANK

INSTALL THERMAL EXPANSION TANK ON COLD WATER SUPPLY LINE, IF CHECK VALVE OR PRESSURE REDUCING VALVE IS USED IN SUPPLY.

PRESSURE RELIEF VALVE RATING SHOULD NOT EXCEED PRESSURE CAPACITY OF ANY COMPONENT IN THE SYSTEM.

PIPING SHOULD CONFORM TO LOCAL CODES.

BALL VALVES ARE SHOWN FOR SERVICING BOILER. HOWEVER, LOCAL CODES SHALL GOVERN THEIR USAGE.

IMPORTANT
SAFETY FLOW SWITCH PROTECTS THE BOILER IN CASE OF WATER SERVICE INTERRUPTION OR CIRCULATOR FAILURE.

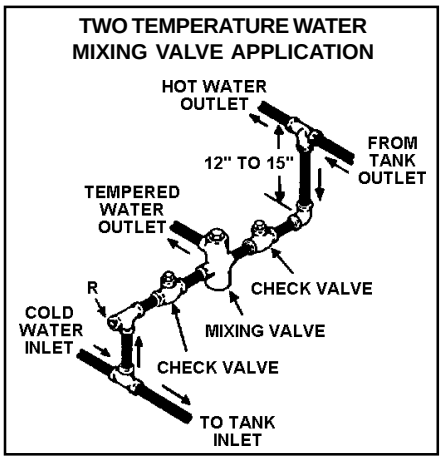
- • PIPE TO OPEN DRAIN
- X FACTORY-INSTALLED ON UNIT
- "" SUPPLIED WITH UNIT
- " FIELD-INSTALLED

⚠ DANGER

TEMPERATURE SETTING SHOULD NOT EXCEED SAFE USE TEMPERATURE AT FIXTURES. SEE WATER TEMPERATURE CONTROL WARNING ON PAGE 26. IF HIGHER PREHEAT TEMPERATURES ARE NECESSARY TO OBTAIN ADEQUATE BOOSTER OUTPUT, ADD AN ANTI-SCALD VALVE FOR HOT WATER SUPPLIED TO FIXTURES.

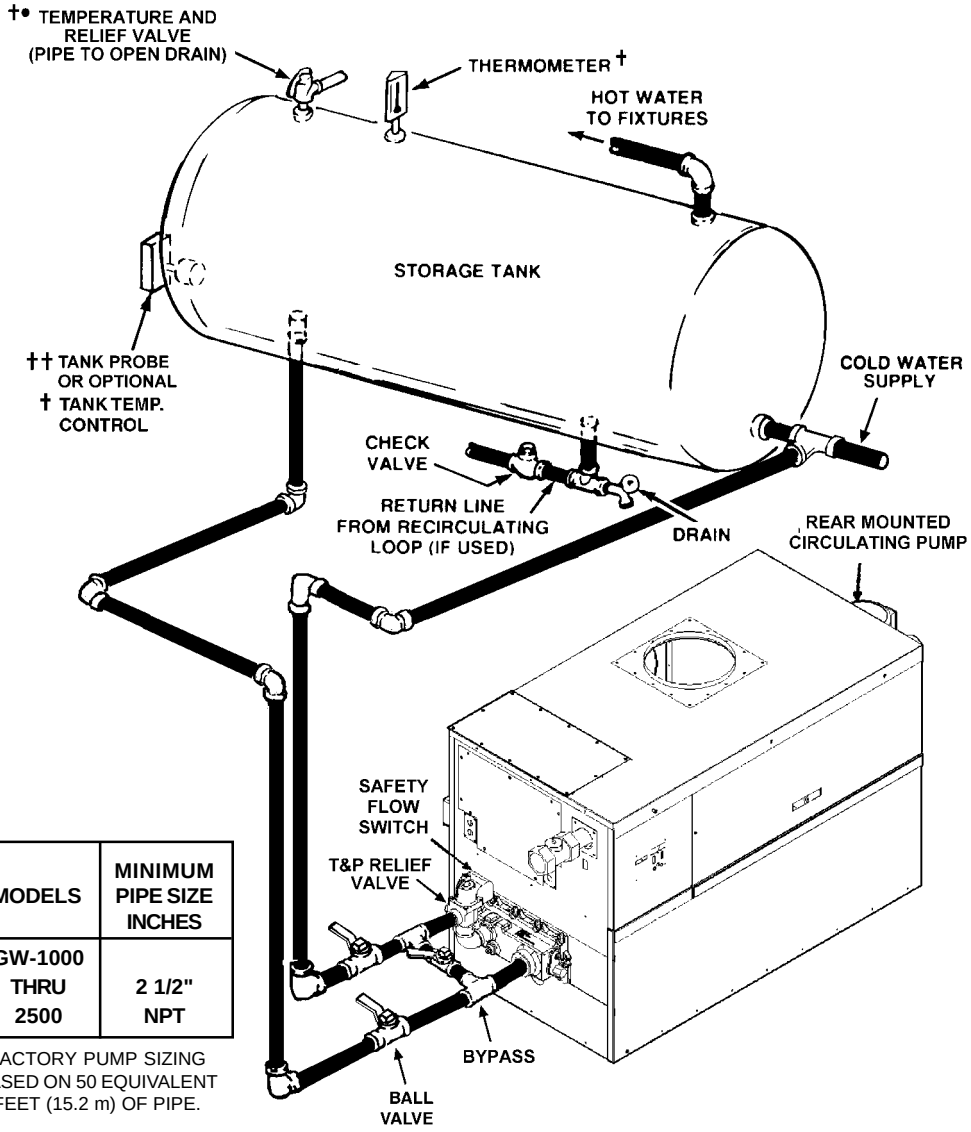
⚠ WARNING

THE WATER MANIFOLD IS NOT DESIGNED TO SUPPORT THE WEIGHT OF THE WATER PIPING SYSTEM. AS ON ALL BOILER INSTALLATIONS, SPECIAL CARE MUST BE TAKEN TO ENSURE PROPER SUPPORT.



CIRCULATING RETURN LINE CONNECTIONS

- • TEMPERED WATER LOOP, IF USED, CONNECT TO POINT R.
- • STORED TEMPERATURE WATER LOOP, IF USED, CONNECT TO ANY OPENING NEAR BOTTOM OF TANK.



MODELS	MINIMUM PIPE SIZE INCHES
GW-1000 THRU 2500	2 1/2" NPT

FACTORY PUMP SIZING BASED ON 50 EQUIVALENT FEET (15.2 m) OF PIPE.

Figure 10. Single boiler with horizontal tank.

Encase field-supplied wires between tank probe and junction box with 1/2" field supplied conduit. "Pigtails" of field-supplied wires should be spliced to "pigtails" of tank probe and connected to 24 VAC junction box (see figure 20). This conduit and wiring should be separate from any other conduit/wiring to guard against EMI (electromagnetic interference).

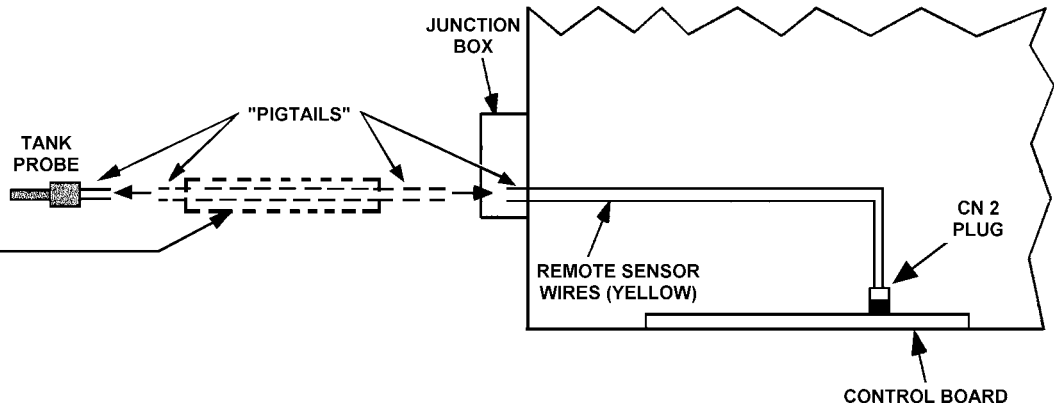


Figure 11. Tank probe installation.

ONE GENESIS (MODEL GW) HOT WATER SUPPLY BOILER WITH VERTICAL TANK

PRESSURE RELIEF VALVE RATING SHOULD NOT EXCEED PRESSURE CAPACITY OF ANY COMPONENT IN THE SYSTEM.

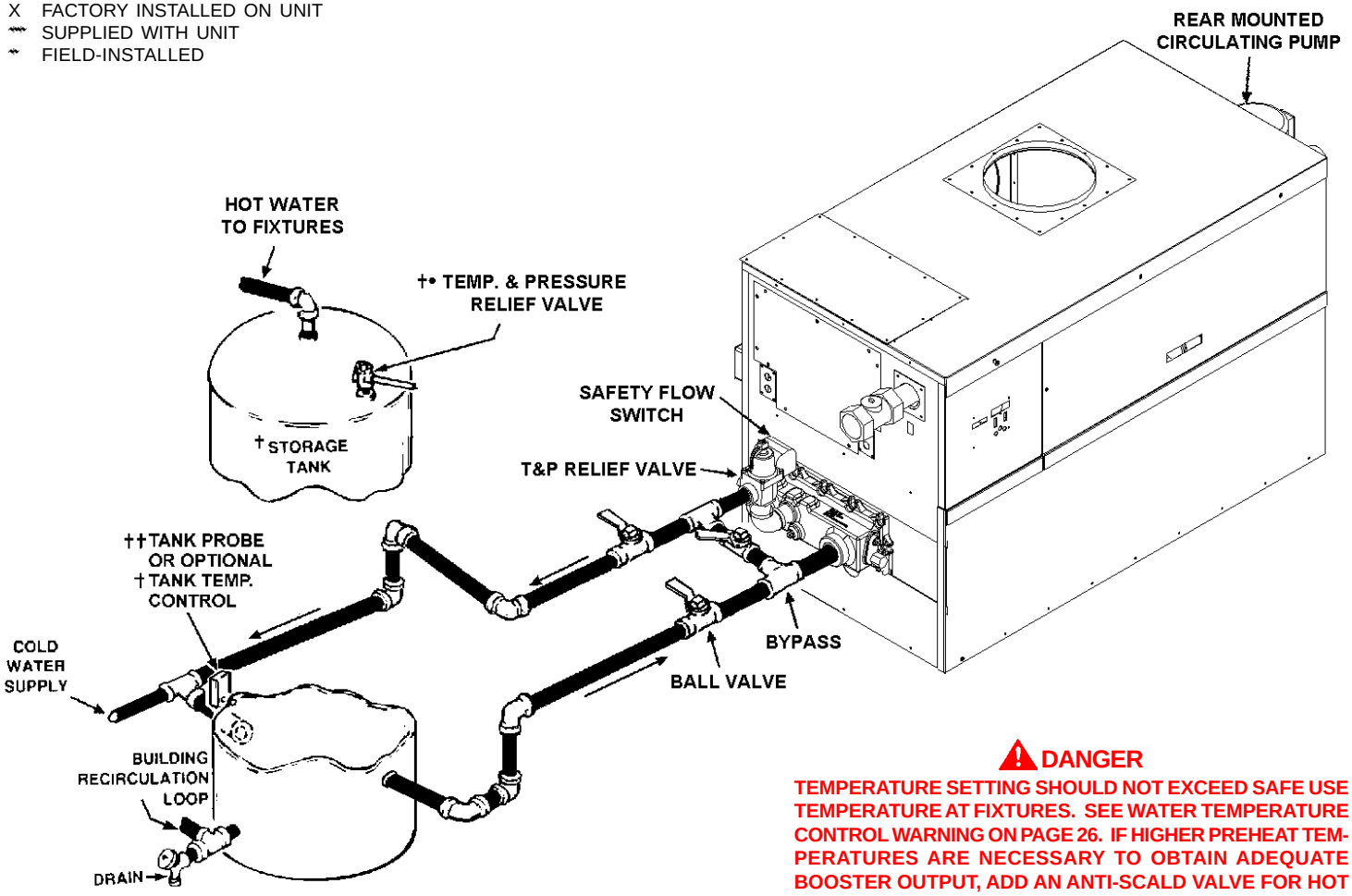
PIPING SHOULD CONFORM TO LOCAL CODES.

BALL VALVES ARE SHOWN FOR SERVICING BOILER. HOWEVER, LOCAL CODES SHALL GOVERN THEIR USAGE.

IMPORTANT

SAFETY FLOW SWITCH PROTECTS THE BOILER IN CASE OF WATER SERVICE INTERRUPTION OR CIRCULATOR FAILURE.

- • PIPE TO OPEN DRAIN
- X FACTORY INSTALLED ON UNIT
- ‴ SUPPLIED WITH UNIT
- ‴ FIELD-INSTALLED



⚠ DANGER

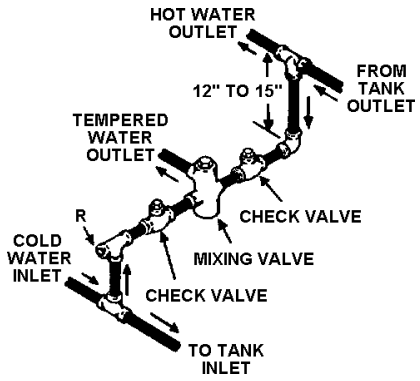
TEMPERATURE SETTING SHOULD NOT EXCEED SAFE USE TEMPERATURE AT FIXTURES. SEE WATER TEMPERATURE CONTROL WARNING ON PAGE 26. IF HIGHER PREHEAT TEMPERATURES ARE NECESSARY TO OBTAIN ADEQUATE BOOSTER OUTPUT, ADD AN ANTI-SCALD VALVE FOR HOT WATER SUPPLIED TO FIXTURES.

INSTALL THERMAL EXPANSION TANK ON COLD WATER SUPPLY LINE, IF CHECK VALVE OR PRESSURE REDUCING VALVE IS USED IN SUPPLY.

MODELS	MINIMUM PIPE SIZE INCHES
GW-1000 THRU 2500	2 1/2" NPT

FACTORY PUMP SIZING BASED ON 50 EQUIVALENT FEET (15.2 m) OF PIPE.

TWO TEMPERATURE WATER MIXING VALVE APPLICATION



CIRCULATING RETURN LINE CONNECTIONS

- TEMPERED WATER LOOP, IF USED, CONNECT TO POINT R.
- STORED TEMPERATURE WATER LOOP, IF USED, CONNECT TO ANY OPENING NEAR BOTTOM OF TANK.

Figure 12. Single boiler with vertical tank.

TABLE 15. Suggested Pipe Size For Multiple Gas Appliances (Natural)

Nominal Iron Pipe Size (Inches)	Maximum Capacity of Pipe in BTU/hr and kW for Gas Pressures of 14 in. W.C. (0.5 psi) or Less and a Pressure Drop of 0.5 in. W.C. (based on 0.60 Specific Gravity Gas w/Heating Value of 1,000 BTU's/Ft³)														
	Length of Pipe in Feet (Metres)														
	Cap.	10 Ft. (3.05)	20 Ft. (6.10)	30 Ft. (9.14)	40 Ft. (12.19)	50 Ft. (15.24)	60 Ft. (18.29)	70 Ft. (21.34)	80 Ft. (24.38)	90 Ft. (27.43)	100 Ft. (30.48)	125 Ft. (38.10)	150 Ft. (45.72)	175 Ft. (53.34)	200 Ft. (60.96)
1 1/4"	BTU/hr	1,400,000	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
	kW	410	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
1 1/2"	BTU/hr	2,100,000	1,460,000	1,180,000	990,000	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
	kW	615	428	346	290	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
2"	BTU/hr	3,950,000	2,750,000	2,200,000	1,900,000	1,680,000	1,520,000	1,400,000	1,300,000	1,220,000	1,150,000	1,020,000	- - -	- - -	- - -
	kW	1,157	805	644	556	492	445	410	381	357	337	299	- - -	- - -	- - -
2 1/2"	BTU/hr	6,300,000	4,350,000	3,520,000	3,000,000	2,650,000	2,400,000	2,250,000	2,050,000	1,950,000	1,850,000	1,650,000	1,500,000	1,370,000	1,280,000
	kW	1,845	1,274	1,031	879	776	703	659	600	571	542	483	439	401	375
3"	BTU/hr	11,000,000	7,700,000	6,250,000	5,300,000	4,750,000	4,300,000	3,900,000	3,700,000	3,450,000	3,250,000	2,950,000	2,650,000	2,450,000	2,280,000
	kW	3,222	2,255	1,830	1,552	1,391	1,259	1,142	1,084	1,010	952	864	776	718	668
4"	BTU/hr	23,000,000	15,800,000	12,800,000	10,900,000	9,700,000	8,800,000	8,100,000	7,500,000	7,200,000	6,700,000	6,000,000	5,500,000	5,000,000	4,600,000
	kW	6,736	4,627	3,749	3,192	2,841	2,577	2,372	2,197	2,109	1,962	1,757	1,611	1,464	1,347

TABLE 16. Suggested Pipe Size For Multiple Gas Appliances (Propane Gas)

Nominal Iron Pipe Size (Inches)	Maximum Capacity of Pipe in BTU/hr and kW for Gas Pressures of 14 in. W.C. (0.5 psi) or Less and a Pressure Drop of 0.5 in. W.C. (based on 1.53 Specific Gravity Gas w/Heating Value of 2,500 BTU's/Ft³)														
	Length of Pipe in Feet (Metres)														
	Cap.	10 Ft. (3.05)	20 Ft. (6.10)	30 Ft. (9.14)	40 Ft. (12.19)	50 Ft. (15.24)	60 Ft. (18.29)	70 Ft. (21.34)	80 Ft. (24.38)	90 Ft. (27.43)	100 Ft. (30.48)	125 Ft. (38.10)	150 Ft. (45.72)	175 Ft. (53.34)	200 Ft. (60.96)
1"	BTU/hr	1,060,800	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
	kW	311	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
1 1/4"	BTU/hr	2,184,000	1,482,000	1,201,200	1,029,600	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
	kW	640	434	352	302	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
1 1/2"	BTU/hr	3,276,000	2,277,600	1,840,800	1,544,400	1,404,000	1,263,600	1,170,000	1,076,400	1,014,000	- - -	- - -	- - -	- - -	- - -
	kW	959	667	539	452	411	370	343	315	297	- - -	- - -	- - -	- - -	- - -
2"	BTU/hr	6,162,000	4,290,000	3,432,000	2,964,000	2,620,800	2,371,200	2,184,000	2,028,000	1,903,200	1,794,000	1,591,200	1,482,000	1,326,000	1,248,000
	kW	1,805	1,256	1,005	868	768	694	640	594	557	525	466	434	388	366
2 1/2"	BTU/hr	9,828,000	6,786,000	5,491,200	4,680,000	4,134,000	3,744,000	3,510,000	3,198,000	3,042,000	2,886,000	2,574,000	2,340,000	2,137,200	1,999,800
	kW	2,878	1,987	1,608	1,371	1,211	1,097	1,028	937	891	845	754	685	626	585
3"	BTU/hr	17,160,000	12,012,000	9,750,000	8,268,000	7,410,000	6,708,000	6,084,000	5,772,000	5,382,000	5,070,000	4,602,000	4,134,000	3,822,000	3,556,800
	kW	5,026	3,518	2,856	2,421	2,170	1,965	1,782	1,690	1,576	1,485	1,348	1,211	1,119	1,042
4"	BTU/hr	35,880,000	24,648,000	19,968,000	17,004,000	15,132,000	13,728,000	12,636,000	11,700,000	11,232,000	10,452,000	9,360,000	8,580,000	7,800,000	7,176,000
	kW	10,508	7,219	5,848	4,980	4,432	4,021	3,701	3,427	3,290	3,061	2,741	2,513	2,284	2,102

WHEN LOCAL CODES REQUIRE A MAIN MANUAL SHUT-OFF VALVE OUTSIDE THE BOILER JACKET, A SUITABLE MAIN MANUAL SHUT-OFF VALVE MUST BE INSTALLED IN A LOCATION COMPLYING WITH THOSE CODES.

IT IS IMPORTANT TO GUARD AGAINST GAS VALVE FOULING FROM CONTAMINANTS IN THE GAS WAYS. SUCH FOULING MAY CAUSE IMPROPER OPERATION, FIRE OR EXPLOSION. IF COPPER SUPPLY LINES ARE USED THEY MUST BE APPROVED FOR GAS SERVICE.

BEFORE ATTACHING THE GAS LINE BE SURE THAT ALL GAS PIPE IS CLEAN ON THE INSIDE.

TO TRAP ANY DIRT OR FOREIGN MATERIAL IN THE GAS SUPPLY LINE, A DIRT LEG (SOMETIMES CALLED DRIP LEG) MUST BE INCORPORATED IN THE PIPING. THE DIRT LEG MUST BE READILY ACCESSIBLE AND NOT SUBJECT TO FREEZING CONDITIONS. INSTALL IN ACCORDANCE WITH RECOMMENDATIONS OF SERVING GAS SUPPLIERS. REFER TO NATIONAL FUEL GAS CODE, ANSI Z223.1 OR CAN/CSA -B149.1 AND .2 (AND LATEST ADDENDA).

THE BOILER AND ITS INDIVIDUAL SHUTOFF VALVE MUST BE DISCONNECTED FROM THE GAS SUPPLY PIPING SYSTEM DURING ANY PRESSURE TESTING OF THAT SYSTEM AT TEST PRESSURES IN EXCESS OF 1/2 PSI (3.5 KPA).

THE BOILER MUST BE ISOLATED FROM THE GAS SUPPLY PIPING SYSTEM BY CLOSING ITS INDIVIDUAL MANUAL SHUTOFF VALVE DURING ANY PRESSURE TESTING OF THE GAS SUPPLY PIPING SYSTEM AT TEST PRESSURES EQUAL TO OR LESS THAN 1/2 PSI (3.5KPA).

Gas Pipe sizing may be larger than heater connections on installations where a significant run of piping is required. To prevent damage, care must be taken not to apply too much torque when attaching gas supply pipe to gas inlet.

Fittings and unions in the gas line must be metal to metal type.

Apply joint compounds (pipe dope) sparingly and only to the male threads of pipe joints. Do not apply compound to the first two threads. Use compounds resistant to the action of liquefied petroleum gases.

1. CORRECT GAS - Make sure gas on which the boiler will operate is the same as that specified on the rating plate. Do not install the boiler if equipped with a different type of gas. Consult your gas supplier.

2A. SIZING GAS SUPPLY LINE (For single boiler installations) see Table 17.

2B. SIZING GAS SUPPLY LINE (For multiple installations of two or more boilers) see Tables 15 (Natural Gas) and 16 (Propane Gas).

TABLE 17. SINGLE UNIT INSTALLATION, SUGGESTED PIPE SIZE

	DISTANCE FROM METER				
BTU INPUT	0-50'	51-100'	101-200'	201-300'	301-500'
990,000	2"	2"	2 1/2"	2 1/2"	2 1/2"
1,300,000	2"	2 1/2"	2 1/2"	3"	3"
1,500,000	2"	2 1/2"	3"	3"	3 1/2"
1,850,000	2 1/2"	2 1/2"	3"	3"	3 1/2"
2,100,000	2 1/2"	3"	3"	3 1/2"	4"
2,500,000	2 1/2"	3"	4"	4"	4 1/2"

Use Tables 15 or 16, which are taken from ANSI booklet Z223.1, NATIONAL FUEL GAS CODE, or CAN/CSA-B149.1and .2 (and latest addenda) to size iron pipe or equivalent gas supply line. Table 17 can be used for single unit installations.

Where it is necessary to use more than the average number of pipe fittings i.e. elbows, tees, and valves in gas supply line, use a pipe larger than specified to compensate for increased pressure drop.

Gas control trains are unique for each Genesis II unit. Stages one, two and three run sequentially left to right on the smaller units (GB/GW 1000 -1500) while stage one is located in different positions on the larger units. Gas manifold diagrams are depicted in Figure 13.

WIRING CONNECTIONS

ALL ELECTRICAL WORK MUST BE INSTALLED IN ACCORDANCE WITH THE MOST RECENT VERSION OF THE NATIONAL ELECTRICAL CODE/CANADIAN ELECTRICAL CODE AND MUST CONFORM TO LOCAL REGULATIONS.

AN ELECTRICAL GROUND IS REQUIRED TO REDUCE RISK OF ELECTRIC SHOCK OR POSSIBLE ELECTROCUTION. Make the ground connection to the wire provided in the electrical supply junction box on the boiler.

Grounding and all wiring connected to this boiler must conform to the local code authority having jurisdiction or, in the absence of such requirements, with the National Electrical Code, ANSI/NFPA 70 or CSA-C22.2 most recent edition.

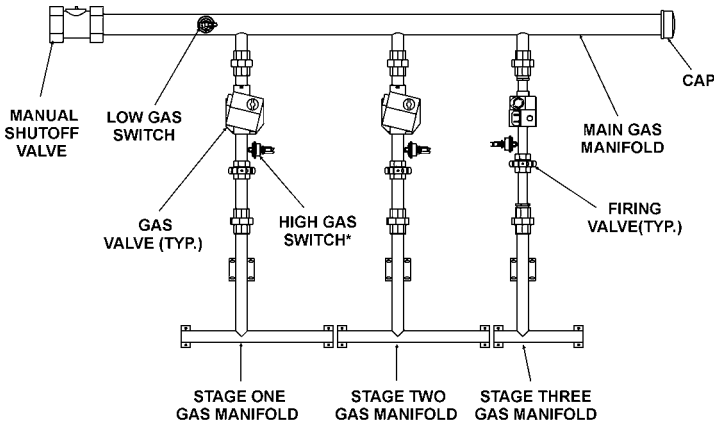
The Central Control Board and Ignition Control Boards that make up the control system are micro-processor based which make them vulnerable to voltage and amperage fluctuations in the power

TABLE 18. Orifice Size for Natural and Propane (LP) Gases (U.S. and Canadian Installations) [Drill size unless otherwise indicated.]

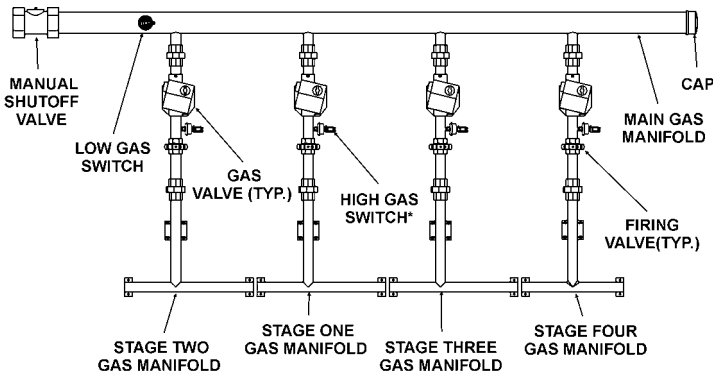
Model	Rating Input BTUH	Number of Burners	Natural (Holes)	Propane (Holes)
G(B,W) 1000	990,000	10	0.111" (4X)	0.071" (3X)
G(B,W) 1300	1,300,000	13	0.111" (4X)	0.071" (3X)
G(B,W) 1500	1,500,000	15	0.111" (4X)	0.071" (3X)
G(B,W) 1850	1,850,000	19	0.111" (4X)	0.071" (3X)
G(B,W) 2100	2,100,000	21	0.111" (4X)	0.071" (3X)
G(B,W) 2500	2,490,000	25	0.111" (4X)	0.071" (3X)

GAS MANIFOLD ASSEMBLY

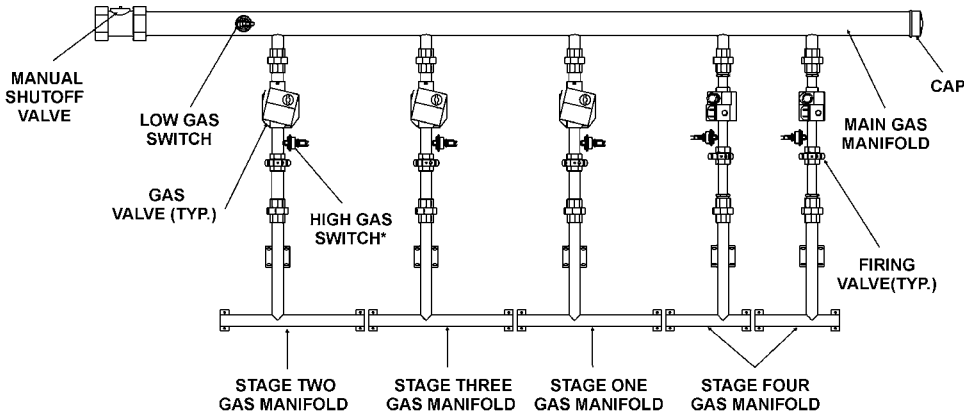
GB/GW 1000 - 1500



GB/GW 1850



GB/GW 2100



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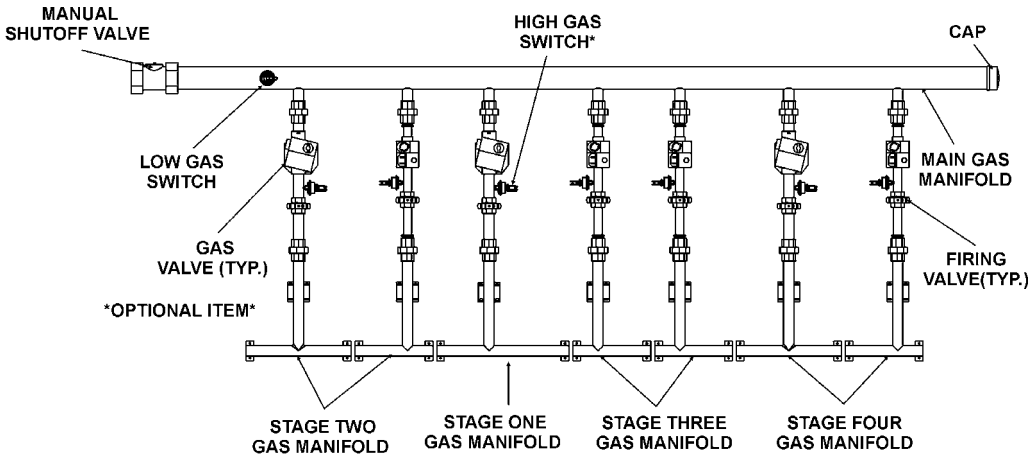


Figure 13. GB/GW 1000 - 2500 Gas Manifold Assembly Diagrams.

supply. **It is imperative that they be protected by a suitable commercial-grade surge protection device.**

IF ANY OF THE ORIGINAL WIRE, AS SUPPLIED WITH THE APPLIANCE, MUST BE REPLACED, IT MUST BE REPLACED WITH TYPE 105°C WIRE OR ITS EQUIVALENT.

The Genesis Hot Water Supply Boiler must be connected to a single phase line source that is:

120 volts, 60 Hertz, and 30 Amps.

The system controller, other than the factory-supplied tank probe (e. g. Honeywell Aquastat) must be wired on the low voltage side (24VAC). Connections are provided in the 24VAC junction box.

Refer to the Schematic Diagram (Figure 21) and the Connection Diagram (Figure 20) for wire connections.

Fuse Protection

The 24VAC circuitry is protected with a 3 amp auto fuse on the Ignition Control Boards and a 5 amp fuse on the Central Control Board. If the fuse opens, a red LED located near the fuse will light, see Figures 14 and 15. If the red LED is illuminated, replace the fuse. **Repeated failure of the fuse is an indication of possible damage to the ignition control.** The 120VAC circuits of each Ignition Control Board is protected with a 10 amp fuse located on the Interface Board. The pump fuse is also on the Interface Board.

Note: Four extra 3 amp fuses and one 5 amp fuse are supplied with the boiler.

Recommended Replacement fuses:
3 Amp: Littlefuse automotive fuse PN 257003
5 Amp: Bussman Automotive fuse PN ATC5

OPERATION

IMPORTANT

Only qualified personnel shall perform the initial firing of the heater. At this time the user should not hesitate to ask the start-up technician any questions regarding the operation and maintenance of the unit. If you still have questions, please contact the factory or your local A.O. Smith representative.

Operation and troubleshooting instructions are included with this manual. By using these instructions, the user may be able to make minor operational adjustments and save unnecessary service calls. The user should not attempt repairs, but should contact a service technician or gas supplier for service.

GENERAL

Never operate the boiler without first making sure the boiler and system are filled with water, in addition:

For hot water supply installations:

- Make sure a temperature and pressure relief valve is installed at the boiler and, if used, the storage tank. Also check for leaks.

For heating boiler installations:

- Make sure that the boiler and system have been purged of air and checked for leaks.

Also be sure to check the gas piping for leaks before beginning the initial firing of the boiler.

FILLING AND PURGING FOR HEATING BOILER INSTALLATION

1. Fast fill system through bypass until pressure approaches desired system pressure. Close bypass valve and permit pressure to be established by the pressure reducing valve.

2. Vent all high points in system to purge system of air.

Provisions should be made to permit manual venting of radiators or convectors.

FILLING FOR HOT WATER SUPPLY BOILER INSTALLATION

1. Close the systems drain valve by turning handle clockwise.

2. Open a nearby hot water faucet to permit the air in the system to escape.

3. Fully open the cold water inlet pipe valve allowing the heater and piping to be filled.

4. Close the hot water faucet as water starts to flow.

5. The heater is ready to be operated.

PURGING OF GAS LINE

Gas line purging is required with new piping or systems in which air has entered.

⚠ CAUTION

PURGING SHOULD BE PERFORMED BY PERSONS EXPERIENCED IN THIS TYPE OF GAS SERVICE TO AVOID RISK OF FIRE OR EXPLOSION. PURGE DISCHARGE MUST NOT ENTER CONFINED AREAS OR SPACES WHERE IGNITION CAN OCCUR. THE AREA MUST BE WELL VENTILATED AND ALL SOURCES OF IGNITION MUST BE DEACTIVATED OR REMOVED.

BEFORE PLACING THE BOILER IN OPERATION, CHECK FOR GAS LEAKAGE. USE A SOAP AND WATER SOLUTION OR OTHER MATERIAL ACCEPTABLE FOR THE PURPOSE OF LOCATING GAS LEAKS. DO NOT USE MATCHES, CANDLES, FLAME OR OTHER SOURCES OF IGNITION FOR THIS PURPOSE.

⚠ WARNING

THE GAS VALVE MUST HAVE BEEN IN THE OFF POSITION FOR AT LEAST 5 MINUTES. This waiting period is an important safety step. Its purpose is to permit gas that may have accumulated in the combustion chamber to clear. IF YOU DETECT GAS ODOR AT THE END OF THIS PERIOD DO NOT PROCEED WITH LIGHTING. RECOGNIZE THAT GAS EVEN IF IT SEEMS WEAK, MAY INDICATE PRESENCE OF ACCUMULATED GAS SOMEPLACE IN THE AREA WITH RISK OF FIRE OR EXPLOSION. SEE THE FRONT PAGE FOR STEPS TO BE TAKEN.

INLET GAS PRESSURE

The inlet gas pressure is measured by removing the low gas pressure switch located on the main gas manifold which is upstream of the unit's combination gas valves; see Figure 13. The maximum value specified in the table must not be exceeded. The minimum values, shown in Table 19, must be maintained under

FOR YOUR SAFETY READ BEFORE OPERATING

WARNING: IF YOU DO NOT FOLLOW THESE INSTRUCTIONS EXACTLY, A FIRE OR EXPLOSION MAY RESULT CAUSING PROPERTY DAMAGE, PERSONAL INJURY OR LOSS OF LIFE.

FLAMMABLE

A. THIS APPLIANCE DOES NOT HAVE A PILOT. IT IS EQUIPPED WITH AN IGNITION DEVICE WHICH AUTOMATICALLY LIGHTS THE BURNER. DO NOT TRY TO LIGHT THE BURNER BY HAND.

B. BEFORE OPERATING: SMELL ALL AROUND THE APPLIANCE AREA FOR GAS. BE SURE TO SMELL NEXT TO THE FLOOR BECAUSE SOME GAS IS HEAVIER THAN AIR AND WILL SETTLE ON THE FLOOR.

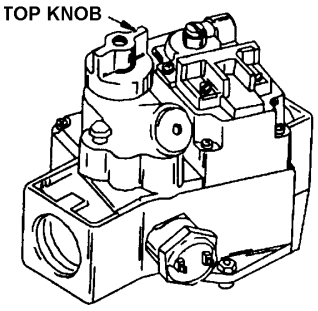
WHAT TO DO IF YOU SMELL GAS

- DO NOT TRY TO LIGHT ANY APPLIANCE.
- DO NOT TOUCH ANY ELECTRIC SWITCH; DO NOT USE ANY PHONE IN YOUR BUILDING.
- IMMEDIATELY CALL YOUR GAS SUPPLIER FROM A NEIGHBOR'S PHONE. FOLLOW THE GAS SUPPLIER'S INSTRUCTIONS.
- IF YOU CANNOT REACH YOUR GAS SUPPLIER, CALL THE FIRE DEPARTMENT.

C. USE ONLY YOUR HAND TO PUSH IN OR TURN THE GAS CONTROL KNOB. NEVER USE TOOLS. IF THE KNOB WILL NOT PUSH IN OR TURN BY HAND, DON'T TRY TO REPAIR IT. CALL A QUALIFIED SERVICE TECHNICIAN. FORCE OR ATTEMPTED REPAIR MAY RESULT IN A FIRE OR EXPLOSION.

D. DO NOT USE THIS APPLIANCE IF ANY PART HAS BEEN UNDER WATER. IMMEDIATELY CALL A QUALIFIED SERVICE TECHNICIAN TO INSPECT THE APPLIANCE AND TO REPLACE ANY PART OF THE CONTROL SYSTEM AND ANY GAS CONTROL WHICH HAS BEEN UNDER WATER.

E. DO NOT OPERATE APPLIANCE UNLESS UNIT IS FILLED WITH WATER AND WATER LINES ARE FULLY OPEN.



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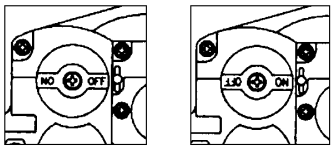
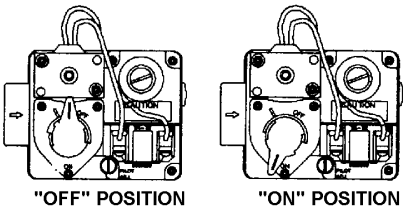


WHITE-RODGERS



Note: Knob cannot be turned to "OFF" unless knob is pushed in slightly. Do NOT force.

OPERATING INSTRUCTIONS

1. STOP! READ THE SAFETY INFORMATION THE NEXT STEP ABOVE ON THIS LABEL.
2. SET THE SYSTEM CONTROLLER TO THE LOWEST SETTING.
3. TURN OFF ALL ELECTRIC POWER TO APPLIANCE.
4. THIS APPLIANCE IS EQUIPPED WITH AN IGNITION DEVICE WHICH AUTOMATICALLY LIGHTS THE BURNER. DO NOT TRY TO LIGHT THE BURNER BY HAND.
5. REMOVE CONTROL ACCESS PANEL.
6. REFER TO DIAGRAMS ABOVE. TURN TOP KNOB OF GAS CONTROL CLOCKWISE TO "OFF" POSITION, (FIGURE A).
7. WAIT FIVE (5) MINUTES TO CLEAR OUT ANY GAS. THEN SMELL FOR GAS, INCLUDING NEAR THE FLOOR.

IF YOU SMELL GAS,

STOP ! FOLLOW "B" IN THE SAFETY INFORMATION ABOVE ON THIS LABEL. IF YOU DON'T SMELL GAS, GO TO THE NEXT STEP.

8. TURN TOP KNOB OF GAS CONTROL COUNTER CLOCKWISE TO "ON" POSITION, (FIG. B).
9. REPLACE CONTROL ACCESS PANEL.
10. TURN POWER SWITCH TO "ON" POSITION.
11. SET THE SYSTEM CONTROLLER TO DESIRED SETTING.
12. IF THE APPLIANCE WILL NOT OPERATE, FOLLOW THE INSTRUCTIONS "TO TURN OFF GAS TO THE APPLIANCE" AND CALL YOUR SERVICE TECHNICIAN OR GAS SUPPLIER.

TO TURN OFF GAS TO APPLIANCE

1. SET THE SYSTEM CONTROLLER TO THE LOWEST SETTING.
2. TURN POWER SWITCH ON APPLIANCE TO "OFF" POSITION.
3. REMOVE ACCESS PANEL TO EXPOSE GAS CONTROL.
4. REFER TO DIAGRAMS ABOVE. TURN TOP KNOB OF GAS CONTROL CLOCKWISE (TO "OFF" POSITION, (FIGURE A).
5. REPLACE CONTROL ACCESS PANEL.

FOR YOUR SAFETY READ BEFORE OPERATING

WARNING: IF YOU DO NOT FOLLOW THESE INSTRUCTIONS EXACTLY, A FIRE OR EXPLOSION MAY RESULT CAUSING PROPERTY DAMAGE, PERSONAL INJURY OR LOSS OF LIFE.

FLAMMABLE

A. THIS APPLIANCE DOES NOT HAVE A PILOT. IT IS EQUIPPED WITH AN IGNITION DEVICE WHICH AUTOMATICALLY LIGHTS THE BURNER. DO NOT TRY TO LIGHT THE BURNER BY HAND.

B. BEFORE OPERATING: SMELL ALL AROUND THE APPLIANCE AREA FOR GAS. BE SURE TO SMELL NEXT TO THE FLOOR BECAUSE SOME GAS IS HEAVIER THAN AIR AND WILL SETTLE ON THE FLOOR.

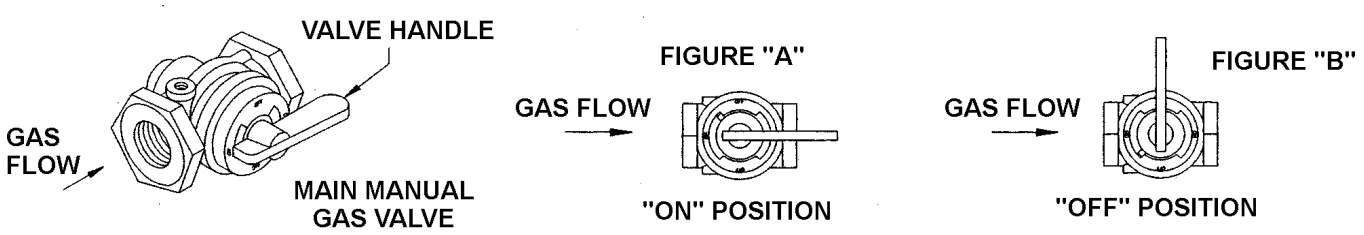
WHAT TO DO IF YOU SMELL GAS

- DO NOT TRY TO LIGHT ANY APPLIANCE.
- DO NOT TOUCH ANY ELECTRIC SWITCH.
- DO NOT USE ANY PHONE IN YOUR BUILDING.
- IMMEDIATELY CALL YOUR GAS SUPPLIER FROM A NEIGHBOR'S PHONE. FOLLOW THE GAS SUPPLIER'S INSTRUCTIONS.
- IF YOU CANNOT REACH YOUR GAS SUPPLIER, CALL THE FIRE DEPARTMENT.

C. USE ONLY YOUR HAND TO TURN THE MAIN MANUAL GAS VALVE HANDLE. NEVER USE TOOLS. IF THE HANDLE WILL NOT TURN BY HAND, DON'T TRY TO REPAIR IT. CALL A QUALIFIED SERVICE TECHNICIAN. FORCE OR ATTEMPTED REPAIR MAY RESULT IN A FIRE OR EXPLOSION.

D. DO NOT USE THIS APPLIANCE IF ANY PART HAS BEEN UNDER WATER. IMMEDIATELY CALL A QUALIFIED SERVICE TECHNICIAN TO INSPECT THE APPLIANCE AND TO REPLACE ANY PART OF THE CONTROL SYSTEM AND ANY GAS CONTROL WHICH HAS BEEN UNDER WATER.

E. DO NOT OPERATE APPLIANCE UNLESS UNIT IS FILLED WITH WATER AND WATER LINES ARE FULLY OPEN.



OPERATING INSTRUCTIONS

1. STOP! READ THE SAFETY INFORMATION ABOVE ON THIS LABEL.
2. SET THE SYSTEM CONTROLLER TO THE LOWEST SETTING.
3. TURN POWER SWITCH ON APPLIANCE TO "OFF" POSITION.
4. TURN MAIN MANUAL GAS VALVE TO "OFF" POSITION, (FIGURE "B"). THE VALVE IS "OFF" WHEN THE HANDLE IS PERPENDICULAR TO THE GAS FLOW DIRECTION.
5. THIS APPLIANCE IS EQUIPPED WITH AN IGNITION DEVICE WHICH AUTOMATICALLY LIGHTS THE BURNER, DO NOT TRY TO LIGHT THE BURNER BY HAND.
6. WAIT FIVE (5) MINUTES TO CLEAR OUT ANY GAS. THEN SMELL FOR GAS, INCLUDING NEAR THE FLOOR. IF YOU SMELL GAS,

   STOP! FOLLOW "B" IN THE SAFETY INFORMATION ABOVE ON THIS LABEL. IF YOU DON'T SMELL GAS, GO TO THE NEXT STEP.
7. TURN MAIN MANUAL GAS VALVE TO "ON" POSITION, (FIGURE "A"), THE VALVE IS "ON" WHEN THE HANDLE IS PARALLEL TO THE GAS FLOW DIRECTION.
8. TURN POWER SWITCH TO "ON" POSITION.
9. SET THE SYSTEM CONTROLLER TO DESIRED SETTING.
10. IF THE APPLIANCE WILL NOT OPERATE, FOLLOW THE INSTRUCTIONS "TO TURN OFF GAS TO THE APPLIANCE" AND CALL YOUR SERVICE TECHNICIAN OR GAS SUPPLIER.

TO TURN OFF GAS TO APPLIANCE

1. SET THE SYSTEM CONTROLLER TO THE LOWEST SETTING.
2. TURN POWER SWITCH ON APPLIANCE TO "OFF" POSITION.
3. TURN MAIN MANUAL GAS VALVE TO "OFF" POSITION, (FIGURE "B"). THE VALVEIS "OFF" WHEN THE HANDLE IS PERPENDICULAR TO THE GAS FLOW DIRECTION.

both load and no load conditions (static and dynamic). The combination gas valves supplied with the boiler are for low pressure service. **If upstream pressure exceeds 14.0" W.C., an intermediate gas pressure regulator of the lockup type must be installed.**

TABLE 19. INLET GAS PRESSURES.

INLET GAS PRESSURE	NAT. GAS	PROP. GAS
MAX. INLET PRESSURE (IN. W.C.)	14.0	14.0
MIN. INLET PRESSURE (IN. W.C.)	6.0	11.0

MANIFOLD PRESSURE

The manifold gas pressure is measured at the pressure tap on the downstream side of the combination gas valve(s). For natural gas the Manifold Pressure should measure 3.5" W.C. For propane (LP) gas, the pressure should read 10" W.C.

IMPORTANT

UNDER NO CIRCUMSTANCES SHALL THE GAS PRESSURE MEASURED AT THE BURNER MANIFOLD EXCEED THAT STATED ON THE BOILER RATING PLATE. OVERFIRING WILL RESULT IN DAMAGE TO THE BOILER, AS WELL AS INCREASED RISK OF FIRE, SOOTING AND ASPHYXIATION.

ADJUSTMENTS

ON INITIAL STARTUP SOME ADJUSTMENTS ARE NECESSARY.

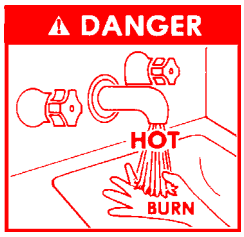
1. CHECK MANIFOLD AND INLET GAS PRESSURES.

2. CHECK THE INPUT. SEE NATIONAL FUEL GAS CODE, ANSI Z223.1 OR CAN/CSA - B149.1 AND .2 (AND LATEST ADDENDA) FOR PROCEDURES.

⚠ DANGER

HOT WATER TEMPERATURES REQUIRED FOR AUTOMATIC DISHWASHER AND LAUNDRY USE CAN CAUSE SCALD BURNS RESULTING IN SERIOUS PERSONAL INJURY AND/OR DEATH. THE TEMPERATURE AT WHICH INJURY OCCURS VARIES WITH THE PERSON'S AGE AND TIME OF EXPOSURE. THE SLOWER RESPONSE TIME OF CHILDREN, AGED OR DISABLED PERSONS INCREASES THE HAZARDS TO THEM. NEVER ALLOW SMALL CHILDREN TO USE A HOT WATER TAP, OR TO DRAW THEIR OWN BATH WATER. NEVER LEAVE A CHILD OR DISABLED PERSON UNATTENDED IN A BATHTUB OR SHOWER.

THE WATER HEATER SHOULD BE LOCATED IN AN AREA WHERE THE GENERAL PUBLIC DOES NOT HAVE ACCESS TO SET TEMPERATURES.



IT IS RECOMMENDED IN DOMESTIC HOT WATER APPLICATIONS THAT LOWER WATER TEMPERATURES BE USED TO AVOID THE RISK OF SCALDING. IT IS FURTHER RECOMMENDED, IN ALL CASES, THAT THE WATER TEMPERATURE BE SET FOR THE LOWEST TEMPERATURE WHICH SATISFIES THE USER'S HOT WATER NEEDS. THIS WILL ALSO PROVIDE THE MOST ENERGY EFFICIENT OPERATION OF THE BOILER AND MINIMIZE SCALE FORMATION IN THE HEAT EXCHANGER, THUS PROLONGING THE LIFE OF THE BOILER.

SETTING THE WATER HEATER TEMPERATURE AT 120°F (49°C) WILL REDUCE THE RISK OF SCALDS. SOME STATES REQUIRE SETTINGS AT SPECIFIC LOWER TEMPERATURES. TABLE 20 BELOW SHOWS THE APPROXIMATE TIME-TO-BURN RELATIONSHIP FOR NORMAL ADULT SKIN.

TABLE 20. RISK OF SCALDS.

TEMPERATURE SETTING	TIME TO PRODUCE 2nd & 3rd DEGREE BURNS ON ADULT SKIN
OVER 170°F (77°C)	NEARLY INSTANTANEOUS
160°F (71°C)	ABOUT 1/2 SECOND
150°F (66°C)	ABOUT 1-1/2 SECONDS
140°F (60°C)	LESS THAN 5 SECONDS
130°F (54°C)	ABOUT 30 SECONDS
120°F (49°C) OR LESS	MORE THAN 5 MINUTES

USE ANTI-SCALD VALVE(S) in the hot water system to reduce the risks of scalding at points of use such as lavatories, sinks and bathing facilities.

CONTROL SYSTEM

DESCRIPTION OF MULTI-STAGE FIRING SYSTEM

The Central Control Board (CCB) is responsible for staging the Ignition Control Boards (ICB) and monitoring safety limit devices, control of circulation pump, power vent, alarm output and IRI gas valves (only on IRI models). The thermostat also resides on the CCB with inputs available for inlet, outlet and tank temperature probes as well as an input for a remote 24VAC thermostat. The CCB has a display interface which connects to the Display Board to show system status and failures. The CCB also has a set of DIP switches which allows the user to control several system parameters; see Figure 14.

The Interface Board, Figure 16, distributes power to the various components of the control system. It also contains test points for the 24VAC devices in the safety circuit, as well as fuses for each of the stage ICBs and the pump. Along the bottom of the Interface Board, several green LEDs show the state of various safety control devices during operation. If the LED is illuminated, the contact to the particular device is in its desired state. To test the 24VAC signal of a device, attach the positive terminal of a multimeter to the test port, run the negative terminal to a suitable ground location and read the voltage. Note: Test ports are the metal terminals located below each of the green LEDs along the bottom of the board.

Each stage requires an Ignition Control Board (ICB) which is responsible for controlling a combustion blower, hot surface igniter and gas valve. Each ICB is capable of monitoring gas valve power, gas valve relay, flame sense and igniter current. The ICB is designed to communicate with the Central Control Board (CCB). Each ICB consists of identical hardware and software. Each stage ICB is made unique through the use of circuit board jumpers which allow the user to control such variables as stage identification and blower/igniter usage. See Figure 15 for jumper configurations.

These jumpers are preset at the factory and should only be adjusted by a qualified service technician.

DIP SWITCH CONFIGURATION TABLE			
SW1	**OFF**	**ON**	**SELECTION:**
A	3 STAGE	4 STAGE	EITHER 3 OR 4 STAGE SYSTEM
B	3 TRIALS	1 TRIAL	EITHER 3 OR 1
C	NO IRI GAS VALVE	IRI GAS VALVE	WHETHER SYSTEM IS IRI OR STANDARD
D	INLET	TANK	INLET OR TANK AS CONTROLLING PROBE
E	NO EXTERNAL THERMOSTAT	EXTERNAL THERMOSTAT	WHETHER EXTERNAL THERMOSTAT IS USED
F	OUTLET 210°F	OUTLET 240°F	OUTLET MAXIMUM TEMPERATURE
G	190°F	220°F	MAX. SET-POINT TEMPERATURE
H	DEGREES °F	DEGREES °C	EITHER °F OR °C FOR DISPLAYED TEMPERATURE

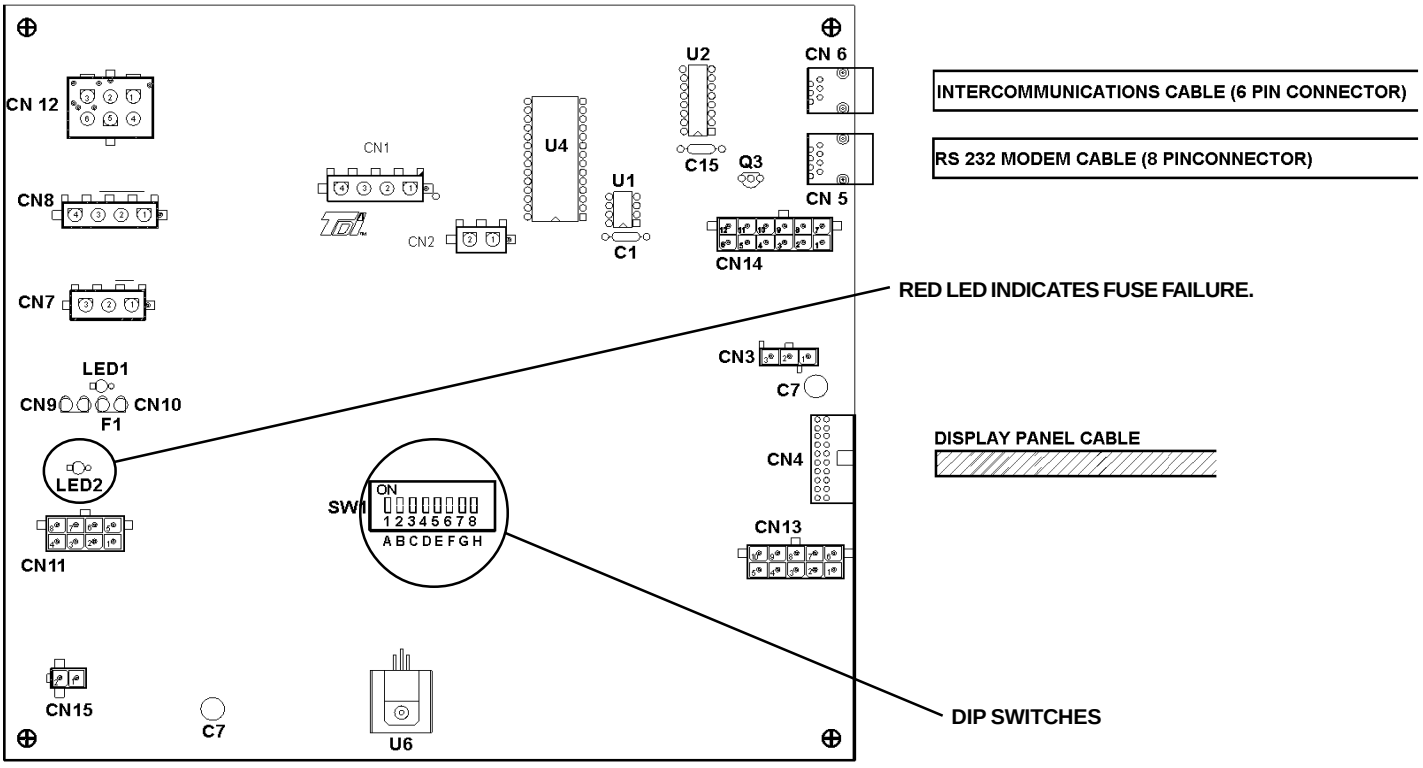


Figure 14. Central Control Board's Dip Switch Configuration and Options

The Display Board, Figure 17, allows the end user to monitor water temperature, set-points, differentials, options, fault indications and error codes. Display Board push-buttons labeled "ADJUST", "SELECT" AND "ENTER/RESET" enable the user to adjust set-points, differentials, post-circulate time, reset the cycle count and reset the control system during lockout. Changes made to programmable features are stored in nonvolatile memory.

DIA-SCAN II DISPLAY BOARD OPERATING PROCEDURES

The Display Board provides a user-friendly interface to the Central Control Board. With the Display Board, the user can control appliance functions and view the overall operating status of the appliance. If an error condition occurs, the Display Board will indicate the nature of the fault by illuminating a red LED. The display will further define the fault by illuminating a red LED corresponding to the stage on which the fault has occurred. Red and green LEDs are associated with each stage to indicate either a fault or normal operation. If the fault continues until the unit "locks out", the display will show a three digit code in addition to the red LEDs. See Table 21 for error code chart. Under normal operating conditions, the four digit LED display on the Display Board will continuously illustrate the water temperature sensed at the inlet temperature probe. If dip switch "D" on the Central Control Board is placed in the "ON" position, it will show the temperature at the tank probe; see Figure 14. The push buttons on the Display Board allow the user to program and view several system parameters described in the following text. The Display Board is connected to the Central Control Board through a 6 conductor cable assembly with modular plug terminations. In addition, an 8 conductor modular jack on the Display Board allows for connecting a remote Display Board.

When power is applied to the Control System, the Display Board will initially run through a self-diagnostic test, and then display the inlet temperature. To display a specific setting or temperature, press the SELECT push-button until the appropriate LED is illuminated; see Figure 17. After 5 seconds, the Display Board will automatically revert to displaying the Inlet temperature. Pressing the ENTER/RESET push-button will hold the display in the indicated mode until the SELECT push-button is pressed.

With the Display Board, the user can make adjustments to many of the appliance's control features. This includes the following:

Options/Features Setting Procedures

- Set Appliance Stage Temperature Set-point Value
- Set Appliance Stage Switching Differential Value
- Select Appliance Post-Circulate Time

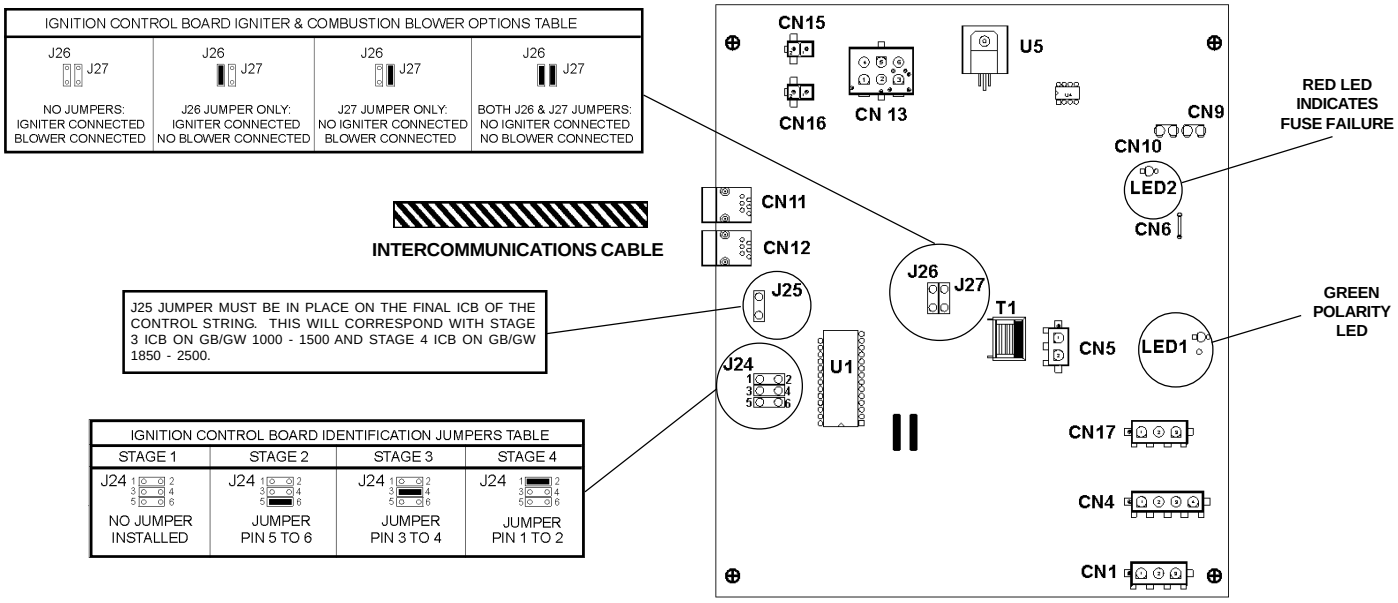


Figure 15. Ignition Control Board Jumper Settings

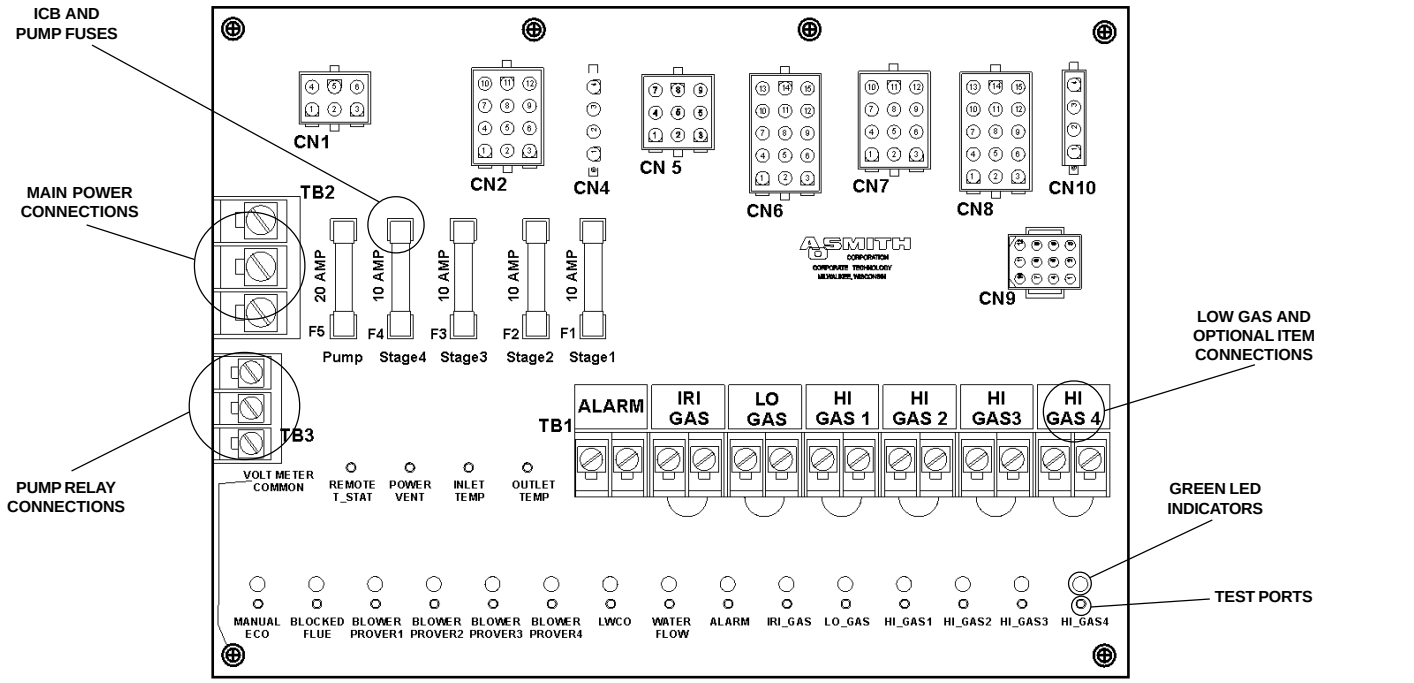


Figure 16. Interface Board Components.

- Check Appliance Cycle Count
- View Last Error Encountered by Control
- Control the water temperature in a storage tank

Green Status Lights

Green LEDs indicate when a given stage has sensed flame and is in the heating state. They also are used to indicate when the Set-Point differential for a given stage is being viewed or adjusted; see Figure 17.

STAGE 1: Stage One in Operation
STAGE 2: Stage Two in Operation
STAGE 3: Stage Three in Operation
STAGE 4: Stage Four in Operation

Red Fault Lights

The Red LEDs are illuminated to show faults and help in trouble shooting. There are three faults (High Gas Fail, LWCO and Power Vent Fail) listed as "Optional" which are only functional when the particular "Optional" equipment is included with the boiler. The red stage LEDs indicate the stage on which a given fault has occurred; see Figure 17.

Blocked Flue:	Blockage in Flue
Probe Fail:	One of the controlling Probes has failed
Insufficient Air:	Not enough Air to Close Switch
Circulate Fail:	Flow Switch Not Closed
Gas Valve Fail:	Relay for Gas Valve in Incorrect State
High Limit:	High Limit has been Exceeded
Flame Fail:	No Flame Sensed upon Ignition

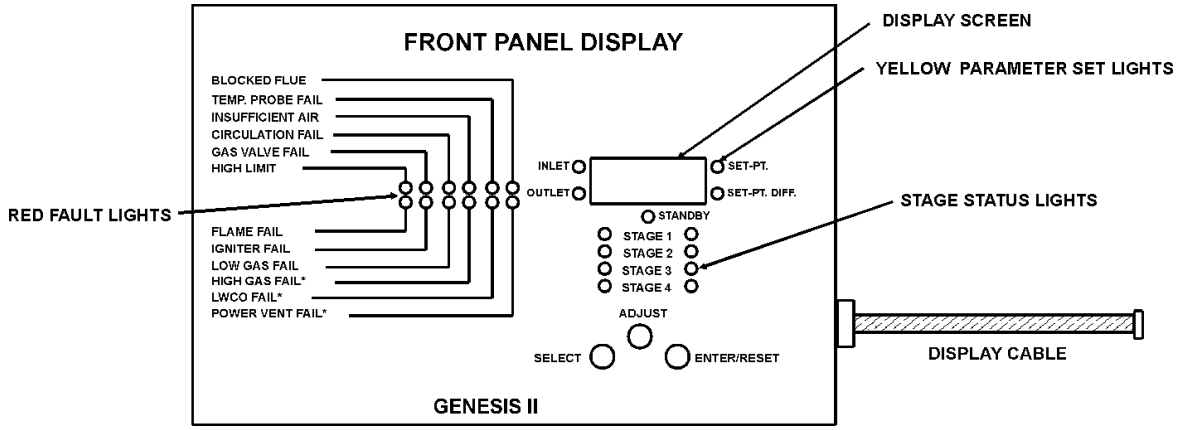


Figure 17. Display Board

Igniter Fail:	Igniter did not reach Minimum Amperage
Low Gas Fail:	Gas Pressure too low to Close Switch
High Gas Fail:	Gas Pressure at Manifold too High
LWCO:	Low water Cutoff activated. Not enough water.
Power Vent Fail:	Not Enough Air to Close Switch
Stage One:	Failure on Stage One
Stage Two:	Failure on Stage Two
Stage Three:	Failure on Stage Three
Stage Four:	Failure on Stage Four

Yellow Parameter Set Lights

The five yellow parameter set lights allow the user to view system set points and options. In conjunction with the four green stage LEDs, the user can monitor and change settings on the various stages; see Figure 17.

Inlet*:	Temperature shown is Inlet Water Temperature.
Outlet:	Temperature shown is Outlet Water Temperature.
Set-Point**:	Indicated probe set-point is being displayed.
Set-Point Differential:	Shows differentials of each stage.
Standby:	Indicates Set-Point is Satisfied. Boiler in Idle State.

*Defaults to tank probe temperature when Dip Switch "D" on Central Control Board is Switched to the "ON" position; see Figure 14.

**Shows set-point temperatures for Inlet/Tank or Outlet in conjunction with yellow parameter lights. See temperature probe section below.

TEMPERATURE PROBES

All units come with two temperature probes connected to the Inlet/ Outlet header. Additionally, an optional tank probe (thermistor type) or 24VAC thermostat/aquastat can be connected to the unit. The probes can be categorized as two types: controlling probes and safety limit probes. Controlling probes can control the staging of the boiler. Safety limit probes are used as resettable high limit switches. The two controlling probes are the inlet probe and the tank probe. The function and setting of the probes is further described in the following sections.

Outlet Probe

The outlet temperature/ECO probe is located on the left side of the header and has two sets of wires embedded in it. The black wires sense the temperature at the probe. Their output is shown on the display screen when the "OUTLET" LED is illuminated. The red wires control the ECO (Emergency Cutoff) which shuts down the unit if the water temperature exceeds 250°F (121°C) and requires a manual reset of the boiler. The outlet probe functions as a automatically resettable high limit and is not considered a controlling probe on the boiler, which means it cannot be set to control the staging of the unit. Depending on the application of the boiler, the probe is set to one of two settings. In GW applications, the maximum Outlet Set Point is 210°F (99°C) and in GB applications it is 240°F (115°C). The outlet probe Set-Point can be adjusted between these two values using Dip Switch "F" on the Central Control Board inside the control box; see Figure 14.

To view the current programmed temperature set-point for the outlet temperature probe:

1. Press the SELECT push-button on the Display Board until both the Set-Pt LED and Outlet Water Temperature LED are illuminated; see Figure 17.

2. The LED display will show the current set-point temperature.

Note: Under no circumstances should the outlet/ECO be set to exceed 210°F (99°C) in applications where the boiler is heating potable water. Failure to observe this will void the warranty.

Inlet Probe

The inlet probe is located on the right side of the Inlet/Outlet header. It has one set of blue wires embedded in it which senses the temperature at the probe. The inlet probe is considered a controlling probe and can be used to control the staging of the unit. The inlet probe Set-Point is fully adjustable between the factory set minimum value of 80°F (25°C) and a user controlled maximum value which will depend on unit's application. In GW applications, the maximum inlet Set-Point is 190°F (88°C) and in GB application it is 220°F (104°C). The inlet probe Set-Point can be adjusted between these two maximum values using Dip Switch "G" on the Central Control Board which is located inside the control box; see Figure 14.

To change or view the current programmed temperature set-point for the inlet temperature probe value:

1. Press the SELECT push-button on the Display Board until both the Set-Pt LED and Inlet Water Temperature LED are illuminated; see Figure 17.
2. The LED display will show the current set-point temperature.

3. Press and hold the ADJUST push-button. The displayed temperature will either increase or decrease. To alternate between increasing or decreasing the temperature, release then press and hold the ADJUST push-button.
4. When the desired set-point temperature is reached, release the ADJUST push-button.
5. Press the ENTER/RESET push-button once, this enters the selected set-point temperature into controller memory.
6. The appliance will now control the temperature to the desired set-point value.
7. For setting the stage differentials, see the section labeled Procedure for Setting Stage Differential.

NOTE: The boiler must complete a full cycle in order for the new setting to take effect. If the unit is turned off prior to a complete cycle the setting will be lost and the previous setting will remain in effect.

24VAC System Controller (Optional)

A 24VAC thermostat/aquastat can be implemented as a system controller on Genesis units. The connection for such devices is located in the 24VAC junction box at the rear of the unit. A 24VAC thermostat/aquastat can only be used as an "On/Off" switch for the unit. The control of the staging will be through either the inlet or tank probe. To use a 24VAC system controller, dip switch "E" on the CCB must be switched to the "on" position; see Figure 14.

Tank Probe (Optional)

In addition to the inlet and outlet/ECO probes, units can be optionally equipped with a tank probe. The connection for the tank probe is located in the 24VAC junction box at the rear of the unit. The tank probe can be configured to control the staging of the unit. See Figure 11 on page 18 for additional information.

Procedure for Setting Tank Probe Temperature

If you have a GW hot water supply boiler, and have installed the tank probe, below are the instructions on how to adjust the water temperature set-point.

1. Press the SELECT push-button on the Display Board until both the Set-Pt LED and Inlet Water Temperature LED are illuminated; see Figure 17.
2. The LED display will show the current set-point temperature.
3. Press and hold the ADJUST push-button. The displayed temperature will either increase or decrease. To alternate between increasing or decreasing the temperature, release then press and hold the ADJUST push-button.
4. When the desired set-point temperature is reached, release the ADJUST push-button.
5. Press the ENTER/RESET push-button once, this enters the selected set-point temperature into controller memory.
6. The appliance will now control the temperature to the desired Set-Point value.
7. For setting the stage differentials, see the section labeled "Procedure for Setting Stage Differential".

Procedure for Setting Stage Differential

Once the system control and set-point temperature has been entered, the switching differentials for the staging of the unit must be established. To facilitate proper operation and maximize appliance performance, each stage has a programmable operating switching differential or “hysteresis” about the set point. This means a call for heat for a particular stage will become active when the water temperature measured at the controlling temperature sensing probe drops to the set-point value minus the switching differential value. It is necessary to set three set-point differential values for three stage units and four for four stage. The burner will remain on until the water temperature measured at controlling probe reaches the stage set-point value. The switching differential value is fully programmable from 0° F to 20°F (0°C to 11°C) using the push-button(s) located on the Display Board.

To change or view the current programmed switching differential:

1. Press the SELECT push-button on the Display Board until both the Set-Pt Diff. and green Stage One LED are illuminated; see Figure 17.
2. The LED display will show the current differential for stage one.
3. Press and hold the ADJUST push-button. The displayed value will either increase or decrease. To alternate between increasing or decreasing the differential, release then press and hold the ADJUST push-button.
4. When the desired Set-Pt differential is reached, release the ADJUST push-button.
5. Press the ENTER/RESET push-button once, this enters the selected set-point deferential into controller memory. To view the Set-Pt minus the Set-Pt differential, press and hold the "ENTER" push-button. This will be the "turn-on" temperature for Stage One and the "turn-off" temperature for Stage Two.
6. Repeat steps 2 through 5 for the rest of the stages.
7. The appliance will now control temperature utilizing the desired differentials.

Example:

Application: **Hydronic Heating**

Desired System Temperature: **185°F (85°C)**

Stage Differentials: **5°F (3°C) per Stage.**

Note: The user must first choose which probe is to control the staging of the unit. The controlling probe will be either the inlet or tank probe. (If the tank probe is used to regulate loop temperature in hydronic applications (GB Models), make sure it is located on the return side of the closed loop.) Use Dip Switch "D" on the Central Control Board to make this selection; see Figure 14.

Set the stage differentials using the procedure described in the "Procedure for Setting Stage Differential" section of the document. Setting the control as described in the above example (5°F differentials for each stage) will give the following stage set-points.

Stage One
Off Temperature: 185°F (85°C)
On Temperature: 180°F (82°C)
Stage Two
Off Temperature: 180°F (82°C)
On Temperature: 175°F (79°C)
Stage Three
Off Temperature: 175°F (79°C)
On Temperature: 170°F (77°C)
Stage Four
Off Temperature: 170°F (77°C)
On Temperature: 165°F (74°C)

Procedure for Setting Pump Delay

The Controller is factory set with a 45 second post circulate function. With the Display Board, the user has the capability to choose between a 45, 90, or 180 second post circulate time period, or turn the pump on continuously. This provides flexibility in selecting the post circulate time to meet specific installation requirements, and improves the efficiency of the circulating pump operation.

To change or view the current programmed post-circulating time:

1. Press the SELECT push-button on the Display Board until the LED display reads "OP" (Options); see Figure 17.
2. To enter into the options mode, press the ENTER/RESET push-button.
3. The display will illustrate "Crcu". Enter this mode by pressing the ENTER/RESET push-button.
4. The display will now illustrate the current post circulate time. Press the ADJUST push-button to select the desired post circulate time (45, 90, 180, "con").
5. When you have selected the desired post circulate time mode, press the ENTER/RESET push-button once, this enters the time into controller memory.
6. The display will automatically return to illustrating the controlling probe temperature after five (5) seconds.

Last Error Mode

In this mode, the Display Board will illustrate the last error which caused the unit to "lock-out". When this mode is entered the three digit failure code that was in memory last will be displayed. See Table 21 for error codes. For example, if the appliance "locked-out" due to insufficient air on stage one, the display will show 041. To enter into this mode, perform the following steps:

1. Press the SELECT push-button on the Display Board until the LED display reads "OP" (Options); see Figure 17.
2. To enter into the options mode, press the ENTER/RESET push-button.
3. The display will illustrate "Crcu". Press the SELECT push-button until the display illustrates "Ler". Enter this mode by pressing the ENTER/RESET push-button.
4. The display will illustrate the last error detected by the control.
5. The display will automatically resort to illustrating the controlling probe temperature after five (5) seconds.

Display Stage Cycle Count

The Central Control Board counts the number of cycles each stage of the appliance has operated by counting how many times the gas valve(s) are energized. To check the cycle count for each stage, perform the following procedure:

1. Press the SELECT push-button on the Display Board until the LED display reads "OP" (Options); see Figure 17.
2. To enter into the options mode, press the ENTER/RESET push-button.
3. The display will illustrate "Crcu". Press the SELECT push-button until the display illustrates "CC". Enter this mode by pressing the ENTER/RESET push-button.
4. The display will now illustrate the current number of cycles stage one has fired. Notice that the green Stage One LED is illuminated. Pressing the ENTER/RESET button again will cause the green Stage Two LED to illuminate and the cycle count for stage two will be displayed on the screen. Cycle counts for the other stages can be viewed in a similar fashion.
5. To reset the cycle count to zero, press the ADJUST push-button. Press the ENTER/RESET push-button to successfully reset the cycle count. If the ENTER push-button is not pressed, the reset function will not be saved and the original cycle count will continue to increment on each gas valve operation.
6. The display will automatically return to illustrating the controlling probe temperature after five (5) seconds.

Appliance Operating Sequence

1. When power is applied to the control system, the Display Board will initially run through a self-diagnostic routine, and then go into its operating mode displaying the temperature sensed at the Inlet probe.
2. If the Central Control Board determines the actual water temperature at the controlling temperature probe is below the programmed temperature set-point minus the switching differential, and the thermostat circuit or tank probe circuit is closed, a call for heat is activated.
3. The control then performs selected system diagnostic checks. This includes confirming the proper state of the ECO/High Limit device, flow switch*****, and pressure switches.

   *Note: Correct water flow is vital to the operation of the boiler. See Table 4 in the Installation manual for requirements on flow, head loss and heat exchanger pressure drop.

4. If all checks are successfully passed, the circulating pump circuit is energized. Once the flow switch has closed, all combustion blowers will energize for a 30 second pre-purge cycle.
5. When the pre-purge cycle is complete, all blowers except stage 1 will drop out. Power is applied to the stage 1 igniter element for the ignitor warm-up period.
6. The control will verify ignitor current. After the verification, the gas valve will open, allowing gas to enter the burner.
7. After an additional 1 second, the control will monitor the flame sense probe to confirm a flame is present. If a flame is not verified within 4 seconds, the gas valve is immediately closed. The control will initiate an 15 second inter-purge period and return to step 2, unless dip switch "B" is in the "ON" position, in which case it will proceed to "lock-out"; see Figure 14.
8. If a flame is confirmed, stage two will be activated. The blower associated with stage two will start. Once the blower has been proven, igniter two will begin its warm-up period. (This is true on all units except the 1000 which has only one igniter.) After the igniter current has been proven, stage two will begin a trial for ignition.
9. Stage three will activate after flame is proven on stage two. If applicable, the blower associated with stage three will begin. Once the blower has been proven, a trial for ignition will begin on stage three. If flame is not proven, there will be a 15 second interpurge on stages with an associated blower. The boiler will then begin additional trials for ignition. On stages without an associated blower, a five second delay will occur before the gas valves are opened for additional trials for ignition.

   Note: Stages on which no blower or igniter is present will bypass the blower and igniter proving periods. The gas valves will open five seconds after a call for heat is initiated on the stage.

10. All stages will remain running until the set point for a given stage is satisfied. If all stages are initiated, stage four will drop out first followed by stages three, two and one. To achieve maximum efficiency, stages will reignite if the system water temperature drops below the stage Set Point minus the Set Point Differential.

Note: Once a stage is satisfied, the blower associated with that stage will allow a 25 second postpurge before it deactivates.

11. Once all of the stages have been satisfied, the pump will run for the programmed post-circulate cycle (factory default 45 seconds). See "Procedure for Setting Pump Delay" section on page 31 of the manual.
12. The control now enters the idle state. This is indicated on the display by the "Standby" LED. The control will continue to monitor temperature and the state of other system devices. If the water temperature at the designated system controller drops below the set-point value minus the switching differential, and the thermostat circuit or tank probe circuit closes, the control will return to step 2 and repeat the entire operating cycle. During this idle state, if the control detects an improper operating state for external devices such as the ECO switch, air pressure switch, gas pressure switch, etc., the appropriate LED(s) on the Display Board will illuminate indicating the nature of the fault.

PREVENTATIVE MAINTENANCE

This is a powered burner and the flame is not supposed to be on the burner. The flame should be just above the burner deck approximately 1/8” and blue in color; see Figure 18.

Visually check flame characteristics through the view port located under the left-hand header on the boiler. Figure 18 shows the normal flame condition. Also, refer to the flame label on the unit (adjacent to the view port).

These boilers are designed to give many years of efficient and satisfactory service when properly operated and maintained. To assure continued good performance, the following recommendations are made.

The area around the unit should be kept clean and free from lint and debris. Sweeping the floor around the boiler should be done carefully. This will reduce the dust and dirt which may enter the burner and heat exchanger, causing improper combustion and sooting.

MAIN BURNERS

Check main burners every three months for proper flame characteristics. The main burner should display the following characteristics:

- Provide complete combustion of gas.
- Cause rapid ignition and carry over of flame across entire burner.
- Give reasonably quiet operation during initial ignition, operation and extinction.
- Cause no excessive lifting of flame from burner ports; see Figure 18.

If the preceding burner characteristics are not evident, check for accumulation of lint or other foreign material that restricts or blocks the air openings to the burner or boiler. To check burners:

1. Shut off all gas and electricity to unit. Allow unit to cool.
2. Remove main burners from unit.
3. Check that burner venturi and ports are free of foreign matter.
4. Clean burners with bristle brush and/or vacuum cleaner. DO NOT distort burner ports.
5. Reinstall burners in unit. Ensure that all the screws on the burner flange are tightened securely so that the gasket will provide a good seal. Also, ensure that each orifice is centered with the venturi opening of every burner. **The washer of the orifice must be inserted a minimum of 1/4" into the burner tube. This is critical for proper operation; see Figure 19.**
6. Also check for good flow of combustion and ventilating air to the unit.

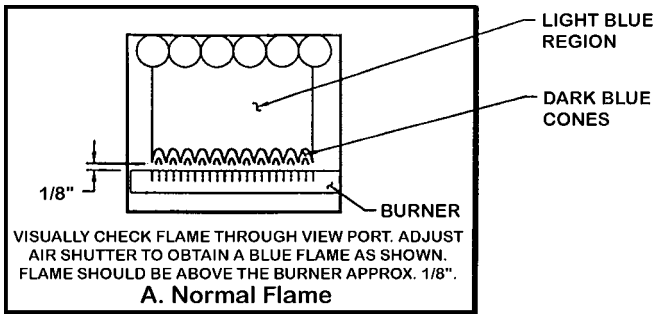


Figure 18. Normal Flame Characteristics

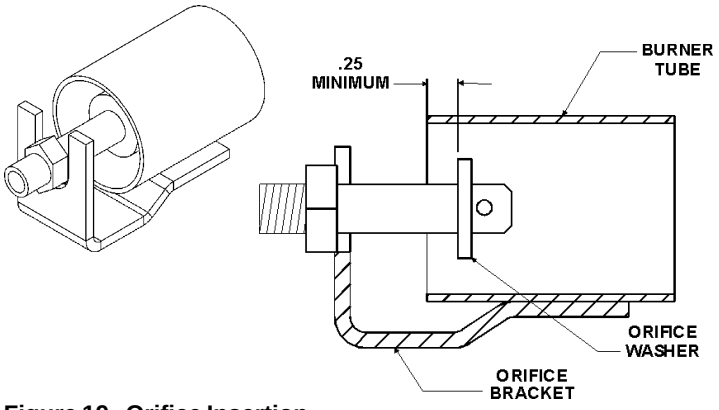


Figure 19. Orifice Insertion

After placing the boiler in operation, check the ignition system safety shut-off devices for proper operation. To accomplish this with the main burners operating, close the valve on the manifold. Within four seconds the main burners should extinguish. If this does not occur immediately, discontinue gas supply by closing main manual shut-off and call a qualified serviceman to correct the situation. If the burners extinguish, then light boiler in accordance with lighting and operating instructions.

For installations above 4,500 feet (1350 m), refer to HIGH ALTITUDE INSTALLATIONS in the installation section.

THE FLOW OF COMBUSTION AIR TO THE BOILER MUST NOT BE OBSTRUCTED.

THE BOILER AREA MUST BE KEPT CLEAR AND FREE FROM COMBUSTIBLE MATERIALS, GASOLINE AND OTHER FLAMMABLE VAPORS AND LIQUIDS.

Any safety devices including low water cutoffs used in conjunction with this boiler should receive periodic (every six months) inspection to assure proper operation. A low water cutoff device of the float type should be flushed every six months. Periodic checks, at least twice a year, should be made for water and/or gas leaks.

More frequent inspections may be necessary depending on water conditions.

The boiler-mounted gas and electrical controls have been designed to give both dependable service and long life. However, malfunction

can occur, as with any piece of equipment. It is therefore recommended that all components be checked periodically by a qualified serviceman for proper operation.

RELIEF VALVE

The safety relief valve should be opened at least twice a year to check its working condition. This will aid in assuring proper pressure relief protection. Lift the lever at the top of the valve several times until the valve seats properly and operates freely.

DANGER

THE WATER PASSING OUT OF THE VALVE DURING CHECKING OPERATION MAY BE EXTREMELY HOT. BEFORE OPERATING RELIEF VALVE, MAKE SURE DRAIN LINE IS INSTALLED TO DIRECT DISCHARGE TO A SAFE LOCATION SUCH AS AN OPEN DRAIN, TO AVOID SCALDING OR WATER DAMAGE.

WARNING

SHOULD OVERHEATING OCCUR OR THE GAS SUPPLY FAIL TO SHUT OFF, TURN OFF THE MANUAL GAS CONTROL VALVE TO THE APPLIANCE.

COMBUSTION AIR FILTER

If the combustion air supply to the boiler contains dust, dirt, drywall dust etc. a filter must be installed. An air filter is not supplied with the boiler as shipped from the factory. The installer must provide a filtering system in the air inlet to the boiler if dust, dirt or construction dirt can be pulled into the boiler through the inlet air piping. Periodically clean air filter per the manufacturer's instructions.

BLOWER COMPARTMENT

The blower compartment should be cleaned annually to remove any dirt and lint that may have accumulated in the compartment or on the blower and motor. Buildups of dirt and lint on the blower and motor can create excessive loads on the motor resulting in higher that normal operating temperatures and possible shortened service life.

VENTING MAINTENANCE

It is recommended that the intake and exhaust piping of the appliance be checked every 6 months for dust, condensate leakage, deterioration and carbon deposits.

WARNING

DO NOT USE A NYLON BRUSH OR OTHER STATIC CREATING MATERIAL TO CLEAN DUST AND CARBON DEPOSITS FROM HEATING SURFACES AND VENT. SUCH DEPOSITS ARE FLAMMABLE AND MAY BE IGNITED BY STATIC ELECTRICITY. USE A METAL BRUSH TO MINIMIZE THE DANGER OF EXPLOSION.

Qualified serviceman should follow this procedure when the boiler's intake and exhaust piping need cleaning:

1. Turn off the electrical power, and manual gas shut-off.
   - Allow boiler parts to cool before disassembly.
2. Remove the vent pipe.
   - Check parts and chimney for obstructions and clean as necessary.
3. Remove burners from boiler and other metal parts as required to clean as necessary.
   - Refer to parts list for disassembly aid.
4. Clean and reinstall the parts removed in steps 2 and 3.
   - Be sure the vent pipe has a minimum upward pitch of 1/4" per foot (2 cm/m) of length and is sealed as necessary.
5. Restore electrical power and gas supply to boiler.
   - Check for gas leaks and proper boiler and vent operation.

HEAT EXCHANGER PREVENTIVE MAINTENANCE

In most water supply systems solids exist. As the water is heated, these tend to drop out depositing as scale or lime. This scale must be removed before the heat exchanger tubes become blocked.

CAUTION

LIME ACCUMULATION CAN REDUCE THE LIFE OF THE EQUIPMENT, REDUCE EFFICIENCY AND WASTE FUEL. BOILER FAILURE DUE TO LIME OR SCALE BUILDUP VOIDS THE WARRANTY.

DELIMING

The amount of calcium carbonate (lime) released from water is in direct proportion to water temperature and usage. The higher the water temperature or water usage, the more lime deposits are dropped out of the water. This is the lime scale which forms in pipes, boilers and on cooking utensils.

The usage of water softening equipment greatly reduces the hardness of water. However, this equipment does not always remove all of the hardness (lime). For this reason it is recommended that a regular schedule for deliming be maintained.

The time between cleaning will vary from two to six months depending upon water conditions and usage. A change of approximately 5°F (3°C) in the normal temperature rise through the boiler is usually an indication that scale should be removed. For long life, copper or brass is recommended for all valves, pipe and fittings.

TUBE CLEANING PROCEDURE
MECHANICAL REMOVAL OF DEPOSITS

Establish a regular inspection schedule, the frequency depends on the local water conditions and severity of service. Do not let the tubes clog up solidly. Clean out deposits over 1/16" (1.6 mm) thickness.

To service heat exchanger tubes, remove return header casting on the side opposite the water connections. Use a U.S. standard 5/8" deep socket ratchet to remove the nuts, exposing the tube ends. Inspect to ensure tubes are free of scale and deposits. If scaled, remove deposits with a stiff wire brush or mechanical tube cleaner to bare metal. Reinstall return header casting. Flush system.

Note: Removal of the heat exchanger is not required.

CAUTION

IF HEAT EXCHANGER MAINTENANCE REQUIRES TUBING REPLACEMENT, SPECIAL PROVISIONS SHALL BE TAKEN TO ENSURE THAT THE DAMAGED TUBES ARE CAREFULLY REMOVED.

REPLACEMENT TUBES MUST BE PROPERLY INSTALLED AND EXPANDED INTO THE ROLLED TUBE TUB.

OVER-ROLLING, MISALIGNMENT OF TUBES OR IMPROPER TIGHTENING OF THE ASSEMBLY MAY RESULT IN LEAKS OR

DAMAGE TO THE HEAT EXCHANGER. CONTACT YOUR A. O. SMITH DEALER FOR DETAILED INSTRUCTIONS.

REPLACEMENT PARTS

Replacement parts may be ordered through A. O. Smith dealers, authorized servicers or distributors. Refer to the Yellow Pages for where to call or contact (in United States) the **A. O. Smith Water Products Company, 5621 West 115th Street, Alsip, IL 60803, 1-800-433-2545 or (in Canada) A. O. Smith Enterprises Ltd., 768 Erie Street, Stratford, Ontario, Canada N5A 6T3, 519-271-5800.** When ordering parts be sure to state the quantity, part number and description of the item including the complete model and serial number as it appears on the product. Refer to the parts lists (P/N 211818-000) for more information.

For Technical Assistance call A. O. Smith Technical Information Center at 1-800-527-1953.

TROUBLESHOOTING

Before any extensive troubleshooting, ensure that:

- Power (120VAC) is supplied to the appliance.
- System control (tank probe, thermostat, etc.) is calling for appliance operation (call for heat).
- Other contacts (switches) are closed (low water cutoff, flow switch, limit controls, pressure switches, etc.)
- Gas supply pressure is within the maximum and minimum operating ranges listed on the appliance rating plate/label.
- Appliance is wired according to wiring diagram.

  NOTE: Shorting the thermostat wiring to ground in the 24VAC circuit will blow the 3 amp fuse.

- All wire terminals/connectors are firmly attached to valves, modules, switches, limit controls, etc.
- There has been no damage caused by freezing, inoperative pumps, etc.

CAUTION

MAKE SURE POWER IS DISCONNECTED FROM MAIN BREAKER BEFORE SERVICING.

CAUTION

LABEL ALL WIRES PRIOR TO DISCONNECTION WHEN SERVICING CONTROLS. WIRING ERRORS CAN CAUSE IMPROPER AND DANGEROUS CONDITIONS. SUCH ERRORS MAY RESULT IN PROPERTY DAMAGE, PERSONAL INJURY OR LOSS OF LIFE.

TROUBLESHOOTING IGNITION SYSTEM

The control system has several features to aid in troubleshooting problems which may occur during operation. If a fault occurs, the Display Board contains sixteen (16) red fault LED indicators to help pinpoint the source of failures. In addition, the display will inform the user on which stage the failure occurred by illuminating a red Stage LED. In cases where the problem persists to lockout, the appropriate red LEDs will remain illuminated and a three digit error code will flash on the display screen. A summary of error codes is given in Table 21. The error codes are broken into two categories: hard lockouts and soft lockout.

Hard Lockouts:
Hard lockouts require a manual reset accomplished by pressing the Enter/Reset push-button on the Display Board. Cycling the power "OFF" and "ON" will not reset the control.

Soft Lockouts:
Soft Lockouts also require a manual reset accomplished by pressing the Enter/Reset push-button on the display board. However, under a soft lockout condition, the control will re-initiate an ignition process after one (1) hour provided the call-for-heat is still present and will continue every hour until the unit is either reset or ignites.

A description of the red fault LEDs and their corresponding functions are as follows.

LED	Controller Function
Blocked Flue	Indicates a blockage or interference at the appliance flue.
Temp. Probe Fail	Indicates failure at one of the temperature probes. Unit will "lock-out" only if controlling probe fails.
Insufficient Air	Indicates air pressure was too low to create a sufficient differential to close the differential pressure switch.
Circulate Fail	Indicates water flow was too low to close the flow switch.
Gas Valve Fail	Monitors Gas Valve relay output. LED is ON when the output relay supplying power to the gas valve(s) is open.
High Limit	Monitors ECO in the Outlet Temperature probe. LED is ON when the ECO is open.
Flame Fail	Monitors the Flame Sense Rod. LED is ON when a signal from the flame rod is not sufficient to indicate flame.
Igniter Fail	Indicates igniter current was too low to meet minimum value which allows trial for ignition to continue.
Low Gas Fail	Inlet gas pressure is not sufficient to close gas pressure switch.
High Gas Fail*	Manifold gas pressure is has exceeded designed maximum value.
LWCO Fail*	Indicates water level in system is too low for safe operation.
Power Vent Fail*	Air pressure at Power Vent Switch is not sufficient for safe operation.

***Optional Equipment - LEDs will illuminate only if equipment is connected to boiler.**

Upon lockout, manually push the ENTER/RESET button on the display panel to restart the boiler.

Verify proper operation after servicing.

TABLE 21. ERROR CODE CHART.

GENESIS II CONTROL - FAULT OPERATION		
FAULT	**ERROR CODES**	**LOCKOUT**
COMMUNICATIONS FAULT (CCB TO ICB)		
STAGE 1:	**001**	**HARD**
STAGE 2:	**002**	**HARD**
STAGE 3:	**003**	**HARD**
STAGE 4:	**004**	**HARD**
ECO/HIGH LIMIT:	**010**	**HARD**
NO GAS VALVE POWER SENSED		
STAGE 1:	**011**	**HARD**
STAGE 2:	**012**	**HARD**
STAGE 3:	**013**	**HARD**
STAGE 4:	**014**	**HARD**
LWCO	**020**	**HARD**
CIRCULATE FAULT (FLOW SWITCH)	**030**	**SOFT**
INSUFFICIENT AIR (AIR PRESSURE SWITCH)		
STAGE 1:	**041**	**SOFT**
STAGE 2:	**042**	**SOFT**
STAGE 3:	**043**	**SOFT**
STAGE 4:	**044**	**SOFT**
BLOCKED FLUE	**060**	**SOFT**
POWER VENT	**070**	**SOFT**
IGNITER FAILURE		
STAGE 1:	**081**	**HARD**
STAGE 2:	**082**	**HARD**
STAGE 3:	**083**	**HARD**
STAGE 4:	**084**	**HARD**
LOW GAS FAILURE	**090**	**HARD**
HIGH GAS FAILURE		
STAGE 1:	**101**	**HARD**
STAGE 2:	**102**	**HARD**
STAGE 3:	**103**	**HARD**
STAGE 4:	**104**	**HARD**
GAS VALVE RELAY FAILURE		
STAGE 1:	**111**	**HARD**
STAGE 2:	**112**	**HARD**
STAGE 3:	**113**	**HARD**
STAGE 4:	**114**	**HARD**
FLAME FAILURE		
STAGE 1:	**121**	**HARD**
STAGE 2:	**122**	**HARD**
STAGE 3:	**123**	**HARD**
STAGE 4:	**124**	**HARD**
PROBE FAULTS		
OUTLET PROBE	**131**	**HARD**
INLET PROBE	**132**	**HARD**
REMOTE PROBE	**133**	**HARD**
IRI GAS VALVE FAILURE	**140**	**HARD**
CPU FAULT	**210**	**HARD**

For additional information please refer to the User's Manual supplied with the boiler or contact:
A.O. Smith Technical Services 7 a.m. to 7 p.m. Central Time at: 1-800-527-1953
Our Internet Site is another source of information 24 hours a day.
http://www.hotwater.com

SEE TABLOID PAGE FOR FIGURE 20

CONNECTION DIAGRAM

SEE TABLOID PAGE FOR FIGURE 21

SCHEMATIC DIAGRAM

NEW BOILER LIMITED WARRANTY

A. O. Smith Corporation, the warrantor, extends the following LIMITED WARRANTY to the owner of this hydronic boiler:

1. If within TEN years after initial installation of the boiler, the heat exchanger shall prove upon examination by the warrantor to be defective in material or workmanship, the warrantor, at his option, will exchange or repair such part or portion. This term is reduced to FIVE years if this boiler is used for volume hot water supply purposes other than hydronic space heating.
   a. This warranty is extended to the owner for all other parts or portion during the FIRST year following initial installation of this boiler.
   b. The warranty on the repair or replacement of the part or portion will be limited to the unexpired term of the original warranty.

2. **CONDITIONS AND EXCEPTIONS**
   This warranty shall apply only when the boiler is installed in accordance with local plumbing and building codes, ordinances and regulations, the printed instructions provided with it and good industry practices. In addition, an appropriately sized safety relief valve certified to the ASME Boiler and Pressure Vessel Code must have been installed and fresh water used for filling and makeup purposes;
   a. This warranty shall apply only when the boiler is used:
      (1) at temperatures not exceeding the maximum setting of its operative and/or high limit control;
      (2) at water pressure not exceeding the working pressure shown on the boiler;
      (3) when filled with boiler water, free to circulate at all times and with the heat exchanger free of damaging scale deposits;
      (4) in a noncorrosive and non-contaminated atmosphere;
      (5) in the United States, its territories or possessions, and Canada;
      (6) at a water velocity flow rate, not exceeding or below the Boiler's designed flow rates;
   b. Any accident to the boiler, any misuse, abuse (including freezing) or alteration of it, any operation of it in a modified form will void this warranty.

3. **SERVICE AND REPAIR EXPENSE**
   Under this limited warranty the warrantor will provide only a replacement part. The owner is responsible for all other costs. Such costs may include but are not limited to:
   a. Labor charges for service removal, repair or reinstallation of the component part;
   b. Shipping, delivery, handling, and administrative charges for forwarding the replacement part from the nearest distributor and returning the claimed defective part to such distributor.
   c. All cost necessary or incidental for any material and/or permits required for installation of the replacement.

4. **LIMITATIONS ON IMPLIED WARRANTIES**
   Implied warranties, including any warranty of merchantability imposed on the sale of this boiler under state law are limited to one (1) year duration for the boiler or any of its parts. Some states or provinces do not allow limitations on how long an implied warranty lasts, so the above limitation may not apply to you.

5. **CLAIM PROCEDURE**
   Any claim under the warranty should be initiated with the dealer who sold the boiler, or with any other dealer handling the warrantor's products. If this is not practical, the owner should contact:

U.S. Customers	Canadian Customers
A. O. Smith Water Products Company	A. O. Smith Enterprises Ltd.
5621 West 115th Street	P. O. Box, 310 - 768 Erie Street
Alsip, IL 60803	Stratford, Ontario N5A 6T3
Telephone: 800 323-2636	Telephone: 800-265-8520

   a. The warrantor will only honor replacement with identical or similar parts thereof which are manufactured or distributed by the warrantor.
   b. Dealer replacements are made subject to in-warranty validation by warrantor.

6. **DISCLAIMERS**
   NO OTHER EXPRESS WARRANTY HAS BEEN OR WILL BE MADE ON BEHALF OF THE WARRANTOR WITH RESPECT TO THE MERCHANTABILITY OF THE BOILER OR THE INSTALLATION, OPERATION, REPAIR OR REPLACEMENT OF THE BOILER. THE WARRANTOR SHALL NOT BE RESPONSIBLE FOR WATER DAMAGE, LOSS OF USE OF THE UNIT, INCONVENIENCE, LOSS OR DAMAGE TO PERSONAL PROPERTY OR OTHER CONSEQUENTIAL DAMAGE. THE WARRANTOR SHALL NOT BE LIABLE BY VIRTUE OF THIS WARRANTY OR OTHERWISE FOR DAMAGE TO ANY PERSONS OR PROPERTY, WHETHER DIRECT OR INDIRECT, AND WHETHER ARISING IN CONTRACT OR TORT.
   a. Some states or provinces do not allow the exclusion or limitation of the incidental or consequential damage, so the above limitations or exclusions may not apply to you.
   b. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state or province to province.

Fill in the following for your own reference. Keep it. Registration is not a condition of warranty. The model and serial number are found on the boiler's rating plate.

Owner_____

Installation Address_____

City and State or Province_____ Postal/Zip Code_____

Date Installed_____ Model No._____ Serial No._____

Dealer's Name_____

Dealer's Address_____ Phone No. _____

FILL IN WARRANTY AND KEEP FOR FUTURE REFERENCE

A. O. SMITH
WATER PRODUCTS
COMPANY

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